Essays on Risk Management and Liquidity, Private Banking and Executive Compensation

DISSERTATION

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Michael R. Reichenecker

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Prof. Alexander F. Wagner, Ph.D.

Prof. Dr. Martin Janssen

The Faculty of Economics, Business Administration and Information Technology of the University of Zurich hereby authorises the printing of this Doctoral Thesis, without thereby giving any opinion on the views contained therein.

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Part I: Introduction

Summary of Research Papers

This dissertation contains three independent research papers that are briefly outlined in this section. All projects have in common that they cover research based in two of the world's most important financial centers. Thus, the first research study deals with the connection of U.S. interbank risk management and U.S. equity market liquidity. The following two papers are located in Switzerland and deal with the determinants of money flows of Swiss private banks, and executive compensation in Switzerland. Then, two research projects concern financial intermediation - one of the central topics of current research in finance. The projects on Swiss private banks and executive compensation in Switzerland addresses two entirely different fields, however both are located in Switzerland. Hence, as Switzerland is one of the major financial and economic centers, it is a main concern to understand central mechanism and challenges that Switzerland faces.

Motivated by the events around the financial crisis in 2007/2008, the first research project "Risk Management and Liquidity" examines the interaction of risk management practices in the U.S. interbank market and the level of liquidity in the U.S. equity market. The examination of the determinants of liquidity is important, as the level of available liquidity primarily affects the scope of asset trading activity. Thus, interbank dealers provide the majority of available funding for investors and speculators in the equity market. These interbank dealers employ active risk management to control their overall exposure and respond to perceived levels of market risk. I provide empirical evidence for the existence of cross-market effects and bidirectional causalities between interbank risk management practices and equity market liquidity. More specifically, I show that the level of perceived risk in the interbank sector seems to be associated with changes in the level of liquidity in the equity market. The empirical analysis further reveals, that primarily interbank tightness and volatility determine the level of perceived risk of interbank dealers. Perceived risk in the interbank sector does not seem to directly interact with liquidity in the equity market. It is the interbank financing activity that appears to serve as the primary transfer mechanism that connects both parts of the market. Furthermore, I show that mutually reinforcing feedback effects between liquidity and risk management exist. These effects lead to a stronger aggregate effect than both initial shocks considered separately. Studying these effects enables me to contribute to the research of why liquidity can suddenly dry up. In particular, I contribute to an existing liquidity dry-up spiral framework by adding empirical evidence for an additional risk management component.

The second paper "Net New Money Flows of Swiss Private Banks" is joint work with Urs Birchler, Daniel Ettlin and Alexander F. Wagner. It is one of the first papers that systematically investigates the determinants of net money flows of Swiss wealth

management banks. We are able to examine an unique dataset of assets under management and net flows of Swiss private banks available to date. In this research project we consider assets under management as the primary source of value creation for private banks. Figures on net new money capture the net change of assets under management during a specific period and comprise the net amount of assets from new and existing clients net of the amount of those clients who withdraw funds or terminate their relationship. Thus, we are able to study the organic growth of the asset base of Swiss private banks. More specifically, net new money figures capture the variation of the asset base in isolation of currency fluctuations, market performance, and interest and dividend payments. We find that reputation is a central asset for Swiss private banks. Thus, private banks that had a negative media appearance in one year, experience lower net new money flows in the following year. Perhaps surprising, we further find evidence that banks with strong equity capitalization obtain less net new money. However, this result could probably be due to unobserved factors that drive both leverage and client acquisition styles. Furthermore, we observe that more cost-efficient banks obtain higher levels of net new money. Finally, we establish that there are important differences in effects across banks, in particular in terms of bank size, and across time, before and after the 2007/08 financial crisis.

The third paper "Executive Compensation and Disclosure of Compensation in Switzerland" is joint work with Alexander F. Wagner. It is one of the first papers that provides a comprehensive overview of the contemporaneous structure of levels of board and executive compensation in Switzerland. We evaluate an unique and comprehensive dataset of executive and board compensation, management and board shareholding information of 100 Swiss listed companies for the time period of 2007 until 2011. We observe that CEO pay in the largest companies decreases substantially over the sample period. Concerning the composition of pay, we document large differences. Thus, top executives of large companies receive more equity based compensation than their counterparts in smaller companies. We further analyze the extent to which Swiss CEOs are rewarded for performance. Concerning the connection of pay and performance, we observe that executive pay is primarily associated with return on assets, return on equity, and lagged total shareholder return. Remarkably, accounting measures are of lower importance. Strikingly, we find that corporate governance is not associated with performance. An additional factor that determines the level of total pay is firm performance that is purely driven by positive sector performance or favorable developments in terms of the exchange rate. We also provide insights into the structure and changes of wealth levels of Swiss executives. Lastly, we address the regulatory perspective and assess the quality of compensation disclosure in compliance with regulatory requirements. We observe a remarkable improvement in disclosure quality over the last three years.

I am grateful to some very outstanding people. In the first place, I want to thank my supervisor, Professor Alexander F. Wagner, for intensive collaboration and outstanding support. Then, I am indebted to Professor Martin Janssen for his willingness to take the co-supervision of my thesis. Additionally, I am much obliged to my coauthors for their individual contribution to the success of our joint research project. I also want to thank my friends and colleagues at the Department of Banking and Finance at the University of Zurich.

Finally, however most important, there are three special people I owe a debt of thanks to. My parents, Natascha and Rudolf, have lied the cornerstone of my education in constantly encouraging and demanding me. Without their outstanding support I would have not been able to draw up this thesis. Then, I am also greatly indebted to my brother, Jurij-Andrei. He always was a truthful counterpart that helped me much – either to solve complex mathematical problems, by changing my way of thinking by offering another perspective, or just by his own unique and special character. Thus, I want to dedicate this thesis to these special and exceptional people – my Parents and my Brother.

Michael R. Reichenecker
Zurich, October 2012

Part II: Research Papers

Risk Management and Liquidity

Michael R. Reichenecker *

October 30, 2012

Abstract

This paper examines the interaction of risk management practices in the U.S. interbank sector and the level of liquidity in the U.S. equity market. Interbank dealers provide the majority of available funding for investors and speculators in the equity market. As these interbank dealers employ active risk management to control their overall exposure, they respond to perceived market risk. I provide empirical evidence for the existence of cross-market effects and bidirectional causalities between interbank risk management practices and equity market liquidity. Specifically, I show that the level of perceived risk in the interbank sector seems to lead to changes in the level of liquidity in the equity market. Primarily interbank tightness and volatility determine the level of perceived risk of interbank dealers. While risk management in the interbank sector does not seem to directly interact with liquidity in the equity market, interbank financing activity appears to serve as the primary transfer mechanism that connects both markets. Furthermore, I show that mutually reinforcing feedback effects between liquidity and risk management exist.

JEL-code: C53, E51, E59, G20

Keywords: Risk management, interbank and financial markets, liquidity, primary dealer

*Reichenecker is a research assistant at the Department of Banking and Finance at the University of Zurich. Office address: Department of Banking and Finance, Plattenstrasse 14, CH-8032 Zurich, Switzerland, Phone: +41-44-634-2938, eMail: michael.reichenecker@bf.uzh.ch.

1. Introduction

This paper provides empirical evidence for an interrelationship between risk management in the interbanking sector and the level of liquidity in the general equity market. The level of available funding for investors and speculators in the equity market is provided by intermediaries who finance themselves in the interbank market. Through this financing activity the interbank sector determines the level of liquidity and thus the scope of trading activity. In order to control their risk exposure, financial intermediaries employ active risk management and respond to perceived liquidity and observed risk by adjusting funding positions.

The central hypothesis - the interaction of risk management practices in the interbank sector and the level of liquidity in the equity market - is derived from an analytical model by Gârleanu and Pedersen (2007). Gârleanu and Pedersen (2007) show that changes in interbank risk management influence market liquidity and alterations in the level of market liquidity further feed back into perceived risk. The basic mechanism is that holding periods in the interbank sector are adjusted to account for prevailing market conditions. More specifically, in response to perceived changes in the risk environment, interbank institutions adjust their exposure and funding positions. Then, liquidity effects arise in the equity market, and the corresponding changes in security prices in turn feed back into the level of perceived risk.

Additionally, Brunnermeier and Pedersen (2008) provide a model that links asset market liquidity and traders' funding liquidity. In their model, market liquidity in illiquid markets is highly sensitive to changes in funding conditions and spiral effects emerge that mutually reinforce each other. A funding shock to speculators is considered to lower market liquidity and increases corresponding margins. Hence, initial losses lead to more restricted speculator funding positions and further increasing margins. Consequently, funding constraints tighten and speculators are forced to reduce existing positions. Thus, existing positions have to become unwinded and, even worse, market participants are put in situations where they have to unwind positions during downturns. These downturning movements connect to a loss spiral where prices drop further, leading to additional selling pressure. As both effect reinforce each other, spiral effects can arise. These spiral effects occur especially in situations when speculators hold large initial positions that are negatively correlated with a demand shocks. Finally, a funding shock could occur that increases market illiquidity and speculators lose even on their existing positions. At the end, speculators are forced

to sell more that further decreases corresponding price levels. These liquidity spirals reinforce each other, implying a larger aggregate effect than the sum of the individual effects.

In providing empirical evidence for the interaction of risk management and liquidity, I extend this liquidity spiral framework of Brunnermeier and Pedersen (2008). The risk management effects connect to their analytical work as an additional spiral effect.

Understanding the determinants of liquidity is important, as the level of available liquidity directly affects the scope of asset trading activity. Especially in over-the-counter transactions liquidity, that is, the availability of a counterparty to trade with, is of major importance. In fact, liquidity is considered as one of the main pillars of the stability of the whole financial system. The recent financial (subprime) crisis in 2008 highlighted the linkages in the financial system. Thus, large losses in the subprime market affected the funding activity in many, unrelated, parts of the financial system. Further, studying potential network effect helps to understand mechanisms that could arise, when parts of the financial system become into trouble. Hence the understanding of mutually reinforcing effects allows regulatory authorities to foresee hazardous developments that could lead to sudden liquidity dry-ups. Furthermore, unexpected or unforeseen vanishing liquidity imperils the stability of the whole financial system.

To see why the interbank market plays such a big role in this analysis, recall that the demand for interbank financing emerges when a leveraged trader, such as a dealer, hedge fund, or investment bank, purchases assets and the amount of the position exceeds its own equity capital. Then, purchased assets can be used as collateral, facilitating speculators to borrow against it. Thus, trading in the equity market requires capital in the form of collateral that connects speculators with parties offering either cash or collateral. Through collateralized lending transactions, interbank dealers provide liquidity to other financial institutions and market participants enabling them to settle their trades. The prevailing instrument of lending transactions are repurchase agreements (in what follows "repos"). A repo is a collateralized financial contract used by market participants to meet short-term liquidity needs. In a repo transaction, a financial intermediary sells a security on the understanding that it will buy it back at a pre-agreed price on a fixed future date. The most typical financing transactions are reverse repo agreements, where a primary dealer provides general collateral that is rehypotecated in further transactions by market participants.

When opening a financing position the financial intermediaries take on a certain level of risk exposure. This exposure is primarily determined by the risk over the life of the agreement as well as

by the timing and market conditions when unwinding the position. In order to maintain solvency and to meet regulatory and rating requirements, intermediary dealers target a fixed probability of failure irrespective of the risk environment. This probability of default is directly tied to a specific ratio of leveraged risk capital to economic capital. Hence, a constant ratio of equity to risk capital is captured by applying a Value-at-Risk(VaR) rule on the intermediaries risk positions.

Situations such as a massive drop in the valuation of collateral or updates on expected future volatility determine the level of perceived risk. In order to maintain a constant probability of default, financial intermediaries react according to their risk management principles and adjust their exposure correspondingly. Thus, holding positions are adjusted by increasing margin requirements for financing transactions in order to scale corresponding positions. Furthermore collateral requirement are altered. Consequently, the overall risk bearing capacity in the market is expected to decrease and speculators face additional selling pressure to unwind even existing positions. Finally, the assessment of the prevailing level of risk is expected to determine the level of intermediaries' financing activity in the interbank market. Then, this financing channel determines the level of liquidity in the equity market. Hence, risk management and the level of collateral available for financing transactions seem to be connected. Therefore, as a first hypothesis, I expect to observe a negative relationship between the level of perceived risk of financial intermediaries and the level of liquidity in the general equity market.

As a second hypothesis, I expect to observe feedback effects between the level of liquidity in the equity market and the level of perceived interbank risk. Thus, in benign economic situations, such as an economic upswing, the forecasted risk declines and more agents are pushed to the equity market. Coincidently with increasing securities prices, the potential funding demand as well as the level of liquidity increases. Hence, as prices, the level of liquidity and market conditions are reflected in the aggregate risk exposure, financing constraints are expected to loosen.

Third, I expect to observe a mutual interaction of both main effects. I expect to find evidence for a multiplier effect where tighter risk management results in more restricted positions that reduces liquidity. Reduced liquidity implies less demand as well as reduced level of potential counterparties that subsequently increases expected selling times. Then, increased selling times and reduced liquidity come along with an increase in expected losses. As active risk-management anticipates these effects, the assessment of risk further tightens and restricts new as well as existing funding positions. More specifically, I expect to observe that these two effects mutually reinforce each other,

resulting in a multiplier effect where tighter risk management results in more restricted positions. Hence, reduced liquidity is associated with an increase in expected selling times. Subsequently, longer selling times come along with an increase in expected losses that further impact the assessment of risk. Furthermore, a reduction of positions that is amplified by restricted funding decreases available liquidity and otherwise translates into reduced risk-bearing capacity and hence increases the time to find a counterparty. Thus, reduced liquidity in the equity market subsequently further implies tighter risk management.

The empirical analysis recognizes that there are further factors that determine the scope of funding in the interbank market. Hence, I control for tightness in the interbank market and volatility in the equity market. I expect to observe that increased tightness in the interbank market is negatively associated with the level of aggregate funding activity. Volatility in the equity market is expected to interact with the prevalent level of liquidity.

I test these hypotheses of mutually interacting spiral effects using hand-collected quarterly Value-at-Risk disclosures of Primary Dealers of the New York Federal Reserve Bank. Furthermore, I include data of Primary Dealer transaction and financing disclosures of the New York Federal Reserve Bank. The equity market is represented by the CRSP universe of stocks. Further I include variables capturing general market conditions such as the three month Libor-OIS and Ted spread as measures of tightness in the interbank market. Additionally, I include volatility captured by the CBOE VIX index.

In order to test these hypotheses I conduct several cross-correlation and Granger-causation tests. Vector autoregression model specifications allow to observe potential lead and lag effects that connect the interbank and equity market. Overall, I provide evidence that the perceived level of risk in the interbank market and the level of liquidity in the equity market seem to be associated. Thus, the level of perceived risk in the interbank markets seems to be directly associated with innovations in the level of liquidity. Primarily interbank tightness and volatility seem to determine the level of perceived risk in the interbank sector. Risk management in the interbank sector does not seem to directly interact with liquidity in the equity market, but interbank financing activity appears to serve as the primary transfer mechanism that connects both markets.

Finally, the impulse-response functions illustrate the mutual interaction of liquidity in the equity market and risk management in the interbank market. In order to provide a first overview about the central finding, Figure 1 depicts the central interaction mechanisms between both markets.

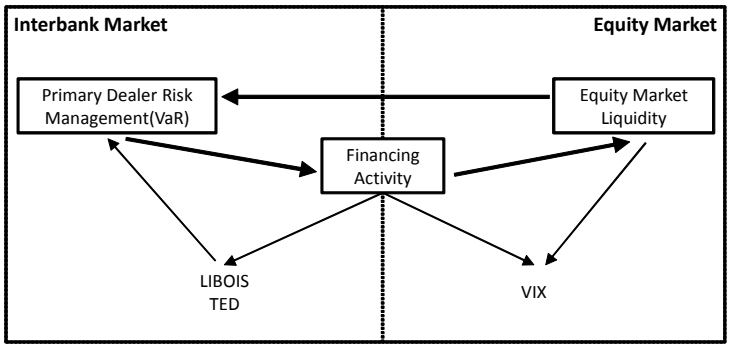

Figure 1. Central interaction mechanisms.

The plan of this paper is as follows. Section 2 puts my work in the context of the current literature and describes the institutional background. Section 3 describes the data. Section 4 provides descriptive statistics. Section 5 examines the relationship between the level of risk management and the level of liquidity in the general stock market. Section 6 concludes.

2. Additional related Literature

Generally there has been very little empirical work on the interaction of interbank risk management practices and equity market liquidity. The subsequent section covers primarily relevant scholars from periphery regions. Basically, the demand for financing arises when a leveraged trader conducts a transaction that exceeds the amount of his own equity. Then, he can use the purchased asset of the transaction and can borrow against it. However, the dealer cannot borrow the entire amount and the remaining margin (haircut) must be financed by the trader. Typically a dealer bank lends funds against collateral in repurchase transactions. Another financing method are security lending transactions where an investor lends a security while accepting other securities or cash as collateral. Both of these financing mechanisms involve in a cycle of continuous lending and rehypotecation of collateral between the interbank sector and other participants in the equity market. Hördahl and King (2008) provide some insight to this securitized-banking system and state that the (former) top U.S. investment banks funded roughly half of their assets using repo markets.

Since margins can be adopted to market conditions on a daily basis, the duration of these lending agreements is short. As a consequence, traders do not carry much excess capital and changes in margins and haircuts force traders to adjust their positions. The funding risk can therefore be split into margin (haircut) funding risk, rollover risk, and redemption risk (Brunnermeier (2009)).

Brunnermeier and Pedersen (2008) provide a model that connects the funding of speculators and market liquidity. They study the interaction between funding and market liquidity and observe that large market shocks trigger to switch to a high margin equilibrium, where markets become illiquid. Hence, financiers set margins in accordance to their risk assessment in order to control their overall risk exposure that is determined by the underlying level of equity. In situations where tighter risk management lets traders hit their capital constraint or they risk to hit it during the live of a trade, they reduce their positions and market liquidity falls as a result ("stabilizing margins"). Furthermore it can happen that they are forced to further de-lever ("destabilizing margins"). These liquidity spirals bring down asset prices and financial institutions capital erodes, while at the same time lending standards and margins tighten. Both liquidity effects can mutually reinforce each other, pushing down prices and tightening funding even further ((Brunnermeier, 2009)). Further, their model implies that market liquidity can suddenly dry up, is related to volatility, and co-moves with the market.

Since liquidity is a priced factor, security prices are also affected (Pástor and Stambaugh (2003) and Amihud (2002)). Additionally, de-leveraging transactions and selling pressure increase the demand for liquidity. Hameed and Viswanathan (2010) provide empirical evidence for a decrease in liquidity and argue that this effect occurs especially during times of tightness in the funding market. Hameed and Viswanathan (2010) show that spillover effects from capital constraints in the market making sector. They state that liquidity dry-ups occur because market participants engage in panic selling (demand effect) and financial intermediaries withdraw from providing liquidity (supply effect) or a combination of both. Therefore market-makers balance sheet and income statement variables determine daily stock market liquidity (Comerton-Forde, Hendershott, Jones, Moulton, and Seasholes (2010)).

Gorton and Metrick (2011) support this view and show that in the crisis of 2008 raising haircuts led to massive constraints in the repo lending for various forms of collateral. Finally that led to massive deleveraging transactions. These effects were observed for many securities for which the repo market offered only overnight loans or shut down completely as reflection of reduced funding capacity. Selling pressure increased and securities prices fell even more (Krishnamurthy (2010) and He and Krishnamurthy (2010)).

Another aspect is the interaction of changes in balance sheet size and leverage. Thus, the asset side of the balance sheets of interbank dealers mainly consists of traded assets and reverse

repos. Traded assets and repos are valued marked-to-market and for short term collateralized loans the book value reflects the current market value. The liability side of interbank balance sheets is characterized by short positions and repurchase agreements that are valued at market prices. Typically long-term debt is of minor importance. The market-value based structure of the balance sheets of financial institutions implies that changes in asset prices show up immediately in their balance sheets. Thus, in situations where the economic environment is benign and forecasted risk declines, asset prices are expected to rise. Hence, the asset side of the balance sheet rises and total leverage, considered as the ratio of total assets to equity, falls correspondingly. The then strengthened balance sheets put the intermediaries in a situation where they hold spare capital. This capital is employed by taking on additional debt to purchase securities to bring leverage back to the initial level.

Adrian and Shin (2010) show that increases in leverage are strongly negatively related with shocks to other risk measures such as lagged CDS spread changes or innovations in lagged implied volatility. In contrast to leverage there seems to exist almost no association between the growth of risk measures and equity. Equity seems to be unaffected by changes in the observed risk environment. Adrian and Shin (2010) conclude that models of risk and economic capital dictate active management of the overall VaR. Thus, financial intermediaries actively adjust their balance sheets in a pro-cyclical manner, such that leverage is high during booms and low during busts.

Basically the aggregate balance sheet size of financial intermediaries determines the level of available liquidity in the equity market. The margin of adjustment of balance sheets is through repos and reverse repos. Apart from that, changes in the dealers' financing and repo activity can be considered as forecasting measure of changes in financial market risk. Adrian and Shin (2010) use the VIX index to capture innovations in financial market risk.

Adrian and Shin (2011) provide a systemic empirical investigation on how banks adjust their balance sheets to actively manage their risk exposure. They show that feedback effects arise where financial intermediaries' balance sheets become stronger as asset prices increase. Thus, a surge in assets prices lets, without adjustments in the asset holdings, total leverage decrease and the financial intermediaries hold excess capital. This surplus capital is employed by borrowing more on the liability side and implies searching for more potential borrowers on the asset side in turn. Thus, larger balance sheets and higher leverage are associated with greater willingness to take on further exposures and an increase in the provision of financing collateral. In these financing transactions

Primary Dealers adjust their liabilities in a way to ensure that their total VaR is proportional to total equity (Adrian and Shin (2011)).

Therefore, the available funding capacity is connected with risk assessment that finally determines the height of leverage. In response to an increase of risk in financial transactions after a shock, the intermediary sector cuts its asset exposures. This allows to keep the probability of default constant and to anticipate potential further shocks. Adrian and Shin (2011) provide empirical evidence that during the recent financial crisis interbank dealers sharply reduced their leverage whereas the ratio of VaR to equity remained fairly constant. Again, this indicates that leveraged financial intermediaries actively manage their balance sheets in order to maintain a constant ratio of VaR to equity. Thus, equity is the pre-determined variable and the size of the balance sheet (total assets) is the endogenous choice variable that is determined by the willingness of banks to take on further risk exposure given the realized value of equity. Finally, the active management of balance sheets leads to pro-cyclical leverage effects where financial intermediaries' leverage is potentially high when total asset prices are generally large.

Lastly, my work is related to Nyborg and Östberg (2010) who work on a connection between the interbank market for liquidity and the broader financial markets. They show that tightness in the interbank market for liquidity leads to "liquidity pull-back"-effects which involve the selling of financial assets either by banks directly or by leveraged investors. This also establishes a connection between the interbank market for liquidity and the broader financial market, which is based on the demand for liquidity by banks.

3. Data

3.1. Interbanking Sector and Risk Management Disclosures

As representatives of the interbank sector I consider the group of Primary Dealers that serve the Federal Reserve Bank of New York (henceforth NY FED) as trading counterparties in its implementation of monetary policy. Primary Dealers are banks and security broker-dealers that trade U.S. Government securities with the Federal Reserve Bank of New York. The NY FED publishes a current list of the institutions being acknowledged as Primary Dealer as well as an archive of revisions since January 1998.[1]

[1] http://www.newyorkfed.org/markets/pridealers_listing.html

The resulting panel of dealer banks is unbalanced, because there are additions to and withdrawals from the list as well as substantial consolidation and internal reorganizations among the group of primary dealers. The sample period lasts from the 4^{th} quarter 1998 until the 1^{st} quarter 2010(46 quarters).

The Securities and Exchange Commission (SEC) requires all large U.S. publicly traded corporations to report quantitative information about their risk management practices in their financial reports filed with the SEC. Registrants may choose from three different reporting methods: (1) a tabular presentation describing fair value under market fluctuations, (2) a sensitivity analysis describing potential changes in fair values under market fluctuations, and (3) VaR numbers. This disclosure requirement is based on the SEC (1997) market risk disclosure rule FRR No. 48 (item 305 of SEC Regulation S-K "Quantitative and Qualitative Disclosures about Market Risk") became effective in 1998 (Jorion (2002)).

The risk management data are publicly available from regulatory filings with the SEC on quarterly 10-Q and yearly 10-K forms.

The VaR is a quantile measure of a potential loss distribution due to adverse market movements over a defined time horizon. Based on regulatory requirements it equals the amount of equity capital that a firm must hold in order to stay solvent with a given probability. VaR captures a loss distribution defined as the smallest benchmark amount such that the probability that the realized loss turns out to be bigger than the benchmark amount is below some fixed probability *(p)*. If a bank were to manage its idiosyncratic risk, emerging from different exposures, by maintaining VaR not to be bigger than its equity capital, the bank would ensure its solvency with at least *(1-p)*. Thus, the VaR summarizes the effect of leverage, diversification, and adverse price movements in a single dollar amount.[2] Usually the VaR estimations are based on historical positions and market data as well as on the underlying assumptions disclosed in the SEC filing.

In the Primary Dealer sample VaRs are reported at either 95% or 99% confidence levels. Therefore the figures across different companies are not readily comparable. To address this constraint, I follow Adrian and Shin (2011) and adjust the VaR figures to an equal confidence level. Hence,

[2] In order to consider the validity of these numbers, it is important to note that the institutions actual loss on a particular day may exceed the amount indicated by the VaR. Thus, the indicated VaR figures do not predict the magnitude of losses that should they occur, may be significantly greater than the projected amount. Thus, an institution's exemplary 95% daily VaR, based on historically observed market risk factor movements, implies that the unrealized loss in its portfolio value would have been exceeded with a frequency of 5% or on one out of 20 trading days.

I scale the VaR to a 99% level by multiplying with $\Phi^{-1}(99)/\Phi^{-1}(95) \approx 1.414$, where Φ^{-1} denotes the inverse CDF of the normal standard distribution.

3.2. Financing Activity

The NY FED collects transactions, positions, financing and settlement data of the Primary Dealers in U.S. Treasury securities, agency debt securities, mortgage-backed securities, and corporate debt securities. Individual positions are reported via form FR 2004 and are publicly available from the website of the NY FED on a weekly consolidated basis since July 4, 2001.[3]

I focus on a subset of this data covering the financing activity of the Primary Dealers. On a gross basis these data are separated into securities that are received by a dealer ("securities in") and delivered securities ("securities out"). A transaction where a dealer enters into a repo in which he borrows funds and provides securities as collateral is considered as "securities out". The financing data are further broken down according to the term of the financing agreement. An overnight financing agreement is an agreement that settles on one business day and matures on the next business day. For example, overnight financing includes a Tuesday to Wednesday agreement. Continuing contracts cover agreements that remain in effect for more than one business day, but have no specific maturity and can be terminated on demand by either the borrower or the lender. A term agreement is an agreement with an original fixed maturity of more than one business day that is not a continuing contract.

Basically, the main financing activity of Primary Dealers is measured by the difference between repos and reverse repos. However this measure does not account for transactions that are tantamount to repo financing activity, but are not reported as such (Adrian and Fleming (2005)). The difference between "securities in" and "securities out", designated as "net financing", and between repo and reverse repo transaction, designated as "net repo financing", allows to captures the net amount of funds that Primary Dealers borrow through all fixed-income securities financing transactions and repo transactions, respectively. This measure encompasses all financing transactions reported by the dealers. These net financing measures account for the funds borrowed by Primary Dealers through financing transactions.

[3] http://www.newyorkfed.org/markets/statrel.html.

3.3. Volume and Returns

The stock market data come from the Centre for Research in Security Prices (CRSP). I consider ordinary common shares that are listed on the NYSE, NASDAQ and AMEX over the period January 1, 1999 until March 31, 2010. By focussing on CRSP share codes 10 or 11 only, I exclude Certificates, American depositary receipts, Shares of Beneficial Interest, Units, Companies incorporated outside the U.S., Americus Trust Components, Close-end funds, and Real Investment Trusts because, their trading characteristics might differ from ordinary equities. Financials are also excluded by removing firms with Standard Industrial Classification (SIC) codes between 6000 and 6999. Additionally I remove stocks whose price exceeds $999 or firms that changes ticker, cusip or exchange; penny stocks are implicitly included. This results in an average of 3871 stocks per day.

3.4. Measurement of Liquidity

Goyenko and Trzcinka (2009) show that useful liquidity measures can be constructed from low-frequency (daily) stock returns and volume data. I follow their suggestion and employ the Amihud (2002) price impact measure of liquidity to capture the scope at which assets are influenced by a trade. Thus, an equity market is considered to be liquid and exhibits a high depth, even if high volume trades do not lead to large price movements. Amihud's (2002) illiquidity measure captures "daily price responses associated with one dollar of trading volume" or, stated differently, the price impact of order flow.

Stock illiquidity is defined as the average ratio of the daily absolute return (absolute change in price) of a stock to its dollar trading volume on that day, i.e. $\frac{|R_{idt}|}{VOLD_{idt}}$. R_{idt} is the return on stock i on day d of time period t and $VOLD_{idt}$ is the daily volume in dollars.

$$ILLIQ_{it} = \frac{1}{D_{it}} \sum_{t=1}^{D_{it}} \left(\frac{|R_{itd}|}{VOLD_{itd}} \right) \tag{1}$$

where, D_{it} is the number of days for which data are available for stock i in time period T. Due to the fact that VaR figures are only available quarterly the subsequent analysis is conducted on a quarterly basis. Thus the average in Equation (1) is taken across observations of stock i for each quarter t, when the recorded volume is positive and the current and past return on days t and *t-1* is non-negative.

3.5. Tightness in the Interbank Market

The state of the interbank market is captured by the Libor-OIS and TED spread. These two spread measures reflect the interbank credit and liquidity differential (Schwarz (2010)). The London Interbank Offered Rate (Libor) is the interest rate paid on unsecured interbank market loans where the borrower receives an agreed amount of money either at call or for a given period of time. Overnight index swaps (OIS) are sequences of overnight bank credits where counterparties agree to exchange the difference between a fixed interest rate and the realized compounded overnight interbank rate. In contrast to Libor loans, OIS transactions exhibit less counterparty risk because at maturity only the differential between the two interest rates is exchanged and the underlying notional is not exchanged. Hence, the difference between the Libor and the OIS rate with the same maturity effectively captures the spread between unsecured and secured loans. Naturally, this ratio is considered to capture the counterparty risk in the secured and unsecured interbank market (Gorton and Metrick (2011)).

The Libor-OIS spread refers to the difference between the 3-month USD Libor and 3-month USD OIS rate. Data for OIS-Libor are available daily, but cover only the period from December 4, 2001 until March 31, 2010. In order to cover the whole period of VaR observations, I include the TED spread as an alternative measure for interbank tightness. The TED spread is the difference between the 3-month USD Libor rate and the 3-month Treasury Bill rate. This implies that the TED-spread can be considered as substitute for the Libor-OIS spread. This is justified, because the in-sample correlation between these two measures on a weekly and monthly weighted averaged basis is 0.928 and 0.925, respectively.

Finally, the aggregate financial market volatility is measured by the VIX index. This index reflects the realized volatility in the S&P 500 Index. The data are downloaded from the Chicago Board of Options Exchange for the whole sample period.

4. Basic Properties of the Data

This section provides an overview of the main variables used to determine the interaction between the level of liquidity in the equity market and the prevailing effects of risk management practices in the interbanking sector. In order to consider the fact that financial institutions' risk management disclosures (VaR) are available only on a quarterly basis, all variables are aggregated over one

quarter.

4.1. Summary Statistics

Table A.1 in the appendix provides a description of the financial institutions that are covered in this paper and the reporting quarters where VaR observations were obtained. In total there are 404 individual hand-collected VaR reportings available, providing an average of around nine VaR observations per quarter.

Table I presents summary statistics for levels and first differences of the variables capturing liquidity in the equity market, the amount of perceived risk in the interbanking sector, data about intermediary financing activity, and variables capturing the status of the interbank and equity markets, respectively.

The panel of VaR-disclosing institutions is averaged by equal weights on a quarterly basis to get one aggregate observation per quarter. Over the period of 46 quarters, the Primary Dealers reported an average VaR of USD 78.83 millions with a standard deviation of USD 49.66 millions.[4]

Over the sample from 1998Q4 until 2010Q1, the average quarterly illiquidity was 0.2593 with a standard deviation of 1.200. Illiquidity is only moderately skewed whereas the VaR measure is highly skewed. The measure for equity market volatility (VIX) is itself quite volatile and highly skewed. Both of the interbank variables ($LIBOIS$ and TED) show similar patterns, which justifies the further use of the TED measure instead of LIBOIS to benefit from the longer time-series availability of this measure.

In order to capture the total amount of financing activity of the interbanking sector, weekly measures of financing activity are summed up for each quarter. Netfinancing ($NETFIN$) and netrepo ($NETREPO$) transaction cover the total sum of quarterly financing activity of Primary Dealers. To get a more differentiated understanding about the financing activity, the financing measures are further broken up according to the maturity of the agreements. Netfinancing and netrepo financing activity on a term basis is captured by $NETFIN_T$ and $NETREPO_T$; overnight and continuing financing activity is measured by $NETFIN_O$ and $NETREPO_O$, respectively. Figure A.2 provides an overview about the aggregated quarterly amounts of Primary Dealer financing activity. A graphical inspection reveals that netrepo transactions exceed netfinancing transaction by around three times. Thus, Primary Dealers lent during the period between 1998Q4 and 2010Q1 an average

[4] Note that the standard deviations essentially refer to quarterly deviations because of quarterly aggregation.

Table I
Summary Statistics

This table presents summary statistics for levels and first differences of the variables capturing liquidity in the equity market, the amount of perceived risk in the interbanking sector, data about intermediary financing activity, and variables capturing the status of the interbank and equity market. ILLIQ stands for Amihud's illiquidity measure, VAR captures the risk management of the Primary Dealers, reported in million USD, VIX stands for the measure of volatility in the equity market, LIBOIS and TED measure the tightness in the interbank market and are reported in percentage points. All of these variables are equally averaged over one quarter and cover the time period between 1998Q4 and 2010Q1. NETFINANCING and NETREPO cover the financing activity of the interbank sector via securities lending and repo transactions, respectively; the suffixes T and O specify the maturity of the contract, where T stands for term and O determines overnight and continuing agreements, respectively. These financing data are reported in million USD and available since July 4, 2001 and are summed up of the corresponding quarters. Panel A reports the statistics for levels and Panel B shows the summary statistics of the first differences of the variables.

	ILLIQ	VAR	VIX	LIBOIS	TED	NETFIN	NETFIN_T	NETFIN_O	NETREPO	NETREPO_T	NETREPO_O
Panel A: Levels											
Mean	2.593	78.832	22.434	29.835	52.523	3615.179	-4748.560	8363.738	11878.520	-1951.644	13830.160
Median	2.381	59.740	21.836	12.533	38.649	3210.199	-5054.765	8111.299	10352.760	-1666.653	13551.150
Standard Deviation	1.200	49.665	8.911	41.251	45.907	1437.081	1471.875	2610.685	4103.151	1081.238	4140.410
Kurtosis	2.410	3.129	7.647	12.055	8.327	3.959	1.543	2.053	1.955	3.403	1.953
Skewness	0.539	1.163	1.691	2.862	2.140	1.340	0.158	0.475	0.545	-0.917	0.292
Range	1.937	56.444	10.304	13.246	45.557	1636.102	2828.383	4226.731	6637.783	1075.620	7270.723
Minimum	0.956	23.640	11.035	6.569	14.467	1925.679	-7271.270	4996.922	6660.480	-4789.890	8030.804
Maximum	5.521	206.863	58.605	210.533	245.206	7716.227	-2411.432	13880.970	19985.630	-128.044	22184.740
Observations	46	46	46	34	46	35	35	35	35	35	35
Panel B: First Differences											
Mean	-0.053	2.101	-0.208	-0.300	-1.715	-3.812	-63.165	59.353	41.022	-53.224	94.246
Median	-0.169	0.103	-0.769	-0.973	0.227	-43.912	-55.016	208.091	391.981	-79.733	279.581
Standard Deviation	0.643	14.973	6.922	31.774	34.093	657.377	543.409	863.549	1173.918	568.130	1088.992
Kurtosis	5.938	9.575	14.184	11.173	9.192	2.893	2.740	3.744	6.956	3.202	3.437
Skewness	0.284	1.820	2.517	0.363	-0.843	0.225	0.403	0.052	-1.996	-0.443	-0.780
Range	0.611	12.813	3.584	4.714	14.808	811.893	637.395	841.803	1030.906	756.533	969.023
Minimum	-2.117	-26.235	-13.605	-109.377	-140.845	-1369.880	-995.466	-2075.599	-4061.974	-1406.117	-2701.593
Maximum	2.035	67.701	33.532	119.310	103.545	1556.684	1148.863	2396.273	1360.718	1007.028	2317.592
Observations	45	45	45	33	45	34	34	34	34	34	34

amount of USD 11.8 billions in repo transactions and USD 3.6 billions in other financing transactions. Interestingly, the amount of securities that Primary Dealers report as incoming exceeds the amount of securities they lend in term financing transaction. Thus, when conduction term financing and term repo transactions Primary Dealers are net long in the market. This pattern reveals that that Primary Dealers purchase securities securities on term agreements and provide their main financing activity in short-run (overnight and continuing) agreements.

Next, in the subsequent analysis I evaluate the data conducting several time series approaches. Generally, the first step in time series analysis is to test whether a time series is stationary. I conduct this analysis using the augmented Dickey Fullers test as well as the Phillips-Perron test. The augmented Dickey-Fuller (1988) test involves to fit a model like in Equation (2) by ordinary

least squares (OLS)):

$$\Delta y_t = \alpha + \beta y_{t-1} + \sum_{j=1}^{k} \zeta_j \Delta y_{t-1} + \epsilon_t \tag{2}$$

where k is the number of lags and ϵ_t is an independently and identically distributed zero-mean error term. I specify the model by allowing for a constant term ($\alpha \neq 0$) and by testing for up to four lags.

Panel A of Table II reports the results of Augmented Dickey-Fuller (ADF) tests for the null hypothesis of a unit root in all interbank and equity market variables. All ADF-test statistics are above the critical values for reasonable levels of significance and indicate the existence of unit-root processes. These results are confirmed in a second test for unit-roots in time series data. The Phillips-Perron (1988) test is justified as it employs Newey-West (1987) standard errors to account for serial correlation. Thus, Phillips and Perron's test statistics can be viewed as Dickey-Fuller statistics that are robust to serial correlation using Newey-West (1987) heteroskedastic- and autocorrelation-consistent covariance matrix estimators. The Phillips-Perron test involves fitting the regression:

$$y_t = \alpha + \rho y_{t-1} + \epsilon_t \tag{3}$$

by OLS with a constant term. The results provide evidence for the indication derived from the previous test. Hence, all test statistics are above the critical values and the null hypothesis cannot be rejected for any of the variables. The implication of this findings is that the further models used to test for causality should be specified in first differences.

Panel B of Table II provides the results after first-differencing each variable: The test statistics for the ADF and Phillips-Perron test are below the critical values for common levels of significance. Hence, taking the first difference of the interbank and equity market variables allows to achieve stationary variables.

4.2. Correlations

Table III presents the time series correlations for levels and first differences of the variables capturing risk management, measures of the state of the equity and interbank market and financing variables.

A first inspection of the level-based panel reveals that there does not seem to exist any correlation between risk management in the interbank sector and the level of liquidity in the equity market. However, both liquidity and risk management variables exhibit significant and positive

Table II
Augmented Dickey-Fuller and Phillips-Perron Unit-root Test Statistics

This table presents test statistics for Dickey-Fuller and Phillips-Perron tests for the existence of unit-roots. DF presents the Dickey-Fuller test statistics and the corresponding critical value at 1%, 5% and 10%, respectively. The same information is presented for the Phillips-Perron Test as well as the corresponding critical values at 1%, 5% and 10%, respectively. The underlying null hypothesis is that the variables contain a unit root, and the alternative is that the variable was generated by a stationary process. Panel A shows the test results for levels of the variables, and Panel B provides test results for first differences variables. ILLIQ stands for Amihud's illiquidity measure, VaR captures the risk management of the primary dealers, VIX stands for the measure of volatility in the equity market, LIBOIS and TED measure the tightness in the interbank market. These data were equally averaged over one quarter and cover the time period between 1998Q4 and 2010Q1. NETFINANCING and NETREPO cover the financing activity of the interbank sector via securities lending or repo transactions; the suffixes T and O specify the maturity of the contract, where T stands for term and O determines overnight and continuing agreements, respectively.

VARIABLES	ADF	Critical Values			p	Perron	Critical Values			p	Obs
		1%	5%	10%			1%	5%	10%		
Panel A: Levels											
ILLIQ	-1.754	-3.614	-2.944	-2.606	0.404	-2.154	-3.614	-2.944	-2.606	0.223	45
VAR	-0.620	-3.614	-2.944	-2.606	0.866	-0.449	-3.614	-2.944	-2.606	0.902	45
NETFIN	-1.453	-3.668	-2.966	-2.616	0.557	-1.767	-3.668	-2.966	-2.616	0.397	37
$NETFIN_O$	-1.459	-3.668	-2.966	-2.616	0.554	-1.548	-3.668	-2.966	-2.616	0.510	37
$NETFIN_T$	-1.620	-3.668	-2.966	-2.616	0.473	-1.534	-3.668	-2.966	-2.616	0.516	37
NETREPO	-0.991	-3.668	-2.966	-2.616	0.756	-1.362	-3.668	-2.966	-2.616	0.601	37
$NETREPO_O$	-1.357	-3.668	-2.966	-2.616	0.603	-1.505	-3.668	-2.966	-2.616	0.531	37
$NETREPO_T$	-0.975	-3.668	-2.966	-2.616	0.762	-1.033	-3.668	-2.966	-2.616	0.741	37
LIBOIS	-2.266	-3.696	-2.978	-2.620	0.183	-2.300	-3.696	-2.978	-2.620	0.172	33
TED	-2.626	-3.614	-2.944	-2.606	0.088	-2.612	-3.614	-2.944	-2.606	0.091	45
VIX	-2.801	-3.614	-2.944	-2.606	0.058	-2.797	-3.614	-2.944	-2.606	0.059	45
Panel B: First Differences											
D.ILLIQ	-4.529	-3.621	-2.947	-2.607	0.000	-4.446	-3.621	-2.947	-2.607	0.000	44
D.VAR	-7.354	-3.621	-2.947	-2.607	0.000	-7.478	-3.621	-2.947	-2.607	0.000	44
D.NETFIN	-4.627	-3.675	-2.969	-2.617	0.000	-4.687	-3.675	-2.969	-2.617	0.000	36
$D.NETFIN_O$	-4.747	-3.675	-2.969	-2.617	0.000	-4.729	-3.675	-2.969	-2.617	0.000	36
$D.NETFIN_T$	-7.189	-3.675	-2.969	-2.617	0.000	-7.327	-3.675	-2.969	-2.617	0.000	36
D.NETREPO	-3.048	-3.675	-2.969	-2.617	0.031	-3.044	-3.675	-2.969	-2.617	0.031	36
$D.NETREPO_O$	-3.379	-3.675	-2.969	-2.617	0.012	-3.358	-3.675	-2.969	-2.617	0.013	36
$D.NETREPO_T$	-5.395	-3.675	-2.969	-2.617	0.000	-5.366	-3.675	-2.969	-2.617	0.000	36
D.LIBOIS	-6.242	-3.702	-2.980	-2.622	0.000	-6.307	-3.702	-2.980	-2.622	0.000	32
D.TED	-7.563	-3.621	-2.947	-2.607	0.000	-7.746	-3.621	-2.947	-2.607	0.000	44
D.VIX	-6.938	-3.621	-2.947	-2.607	0.000	-7.104	-3.621	-2.947	-2.607	0.000	44

correlation with the variables capturing the tightness in each of the underlying markets. Thus, tightness in the equity market, captured by *VIX*, correlates positively with illiquidity and risk management variables. Tightness in the interbank market, captured by *LIBOIS* or *TED*, is also positively associated with risk management variables in the interbank market and liquidity in the equity market. Naturally, the correlations analysis reveals that the scope of correlation is higher between the variable capturing the level of risk and the corresponding underlying market.

As expected, both financing measures are largely correlated with the level of perceived risk of the financial institutions and the scope of correlation is higher for netfinancing activity. Thus, an

increase in financing activity, increases the exposure that is associated with an increase in capital at risk. Then, as previously seen, Primary Dealers are net long in financing transactions with term maturity. This pattern is also reflected in the correlations as both netfinancing and netrepo on a term basis are negatively associated with perceived risk. Contrary to that, liquidity in the equity market is only significantly correlated with netrepo financing measures in total and split into different maturities. This seems to reflect the fact that repo financing is more important as it provides larger amounts of collateral. The association between repo financing and equity market illiquidity is negative and indicates that increasing repo funding increases the amount of available collateral for market transactions that further increases trading and finally influences the prevailing level of liquidity.[5]

Further, a first indication for a connection between the interbank and equity market arises from the positive and significant correlation between tightness in the interbank market (*LIBOIS* and *TED*), and volatility in the equity market (*VIX*). Additionally, tightness in the interbank market is positively associated with aggregated financing activity. Thus, netfinancing and netrepo measures are highly significantly correlated with *LIBOIS* and *TED*.

This first analysis of correlations in levels allows to assume the existence of a potential association between risk management in the interbank market and liquidity in the equity market. While, there does not seem to arise a direct association but potential connection mechanisms arise. Hence, liquidity and risk management are both mutually correlated with tightness measures of both markets as well as with financing activity. The financing measures are also correlated with risk management and liquidity. Thus, it seems plausible to consider measures of tightness and financing variables as potential transfer variables.

Panel B of Table III reports the correlations after first differencing the variables of panel A. It turns out that changes in liquidity in the equity market are highly significantly correlated (0.52) with changes in risk management. Next, an increase in the changes in perceived risk that Primary Dealers face in the interbank market seems to be transferred to the equity market as illiquidity increases there. Reportings of marked-related tightness measures and risk management reveals, that differencing of the variables has almost no impact on the correlation of these measures. Like in the previous analysis of levels, the differences of equity market volatility, interbank tightness, liquidity and risk management are strongly positively and highly significantly correlated with each

[5] Note that increasing levels of liquidity are captured by a decrease in the Amihud Illiquidity measure.

Table III
Correlations

This table presents the correlation matrix for the time series of interbank market, equity market and interbank financing variables. Panel A shows the correlations in levels of the variables, and Panel B provides the correlations for the first differences of the variables. ILLIQ stands for Amihud's illiquidity measure, VAR is capturing the risk management of Primary Dealers, VIX stands for the measure of volatility in the equity market, LIBOIS and TED measure tightness in the interbank market. These data were equally averaged over one quarter and cover the time period between 1998Q4 and 2010Q1. NETFINANCING and NETREPO cover the financing activity of the interbank sector via securities lending or repo transactions; the suffixes T and O specify the maturity of the contract, where T stands for term and O determines overnight and continuing agreements, respectively.

	ILLIQ	VAR	VIX	LIBOIS	TED	NETFIN	$NETFIN_T$	$NETFIN_O$	NETREPO	$NETREPO_T$	$NETREPO_O$
Panel A: Correlations in Levels											
ILLIQ	1.000										
VAR	0.026	1.000									
VIX	0.858***	0.389***	1.000								
LIBOIS	0.595***	0.716***	0.789***	1.000							
TED	0.300**	0.551***	0.560***	0.928***	1.000						
NETFIN	0.012	0.573***	0.199	0.581***	0.769***	1.000					
$NETFIN_T$	0.210	-0.788***	-0.091	-0.462***	-0.586***	-0.611***	1.000				
$NETFIN_O$	-0.112	0.760***	0.161	0.583***	0.754***	0.895***	-0.900***	1.000			
NETREPO	-0.434***	0.374**	-0.234	0.270	0.570***	0.820***	-0.710***	0.852***	1.000		
$NETREPO_T$	-0.292*	-0.748***	-0.491***	-0.486***	-0.343**	-0.089	0.575***	-0.373**	0.097	1.000	
$NETREPO_O$	-0.353**	0.566***	-0.104	0.399**	0.655***	0.835***	-0.854***	0.941***	0.966***	-0.165	1.000
(b) Correlations in First Differences											
ILLIQ	1.000										
VAR	0.523***	1.000									
VIX	0.794***	0.610***	1.000								
LIBOIS	0.604***	0.618***	0.811***	1.000							
TED	0.454***	0.471***	0.658***	0.944***	1.000						
NETFIN	-0.077	0.15	-0.024	0.117	0.229	1.000					
$NETFIN_T$	-0.261	-0.244	0.044	0.121	0.187	-0.026	1.000				
$NETFIN_O$	0.106	0.268	-0.046	0.013	0.056	0.777***	-0.649***	1.000			
NETREPO	-0.339**	-0.221	-0.292*	-0.135	0.027	0.747***	-0.044	0.597***	1.000		
$NETREPO_T$	-0.518***	-0.467***	-0.293*	-0.201	-0.106	0.046	0.669***	-0.386**	0.386**	1.000	
$NETREPO_O$	-0.096	0.005	-0.162	-0.041	0.084	0.782***	-0.397**	0.845***	0.877***	-0.106	1.000

*p<0.10,**p<0.05, ***p<0.01

other.

However, considering interbank financing activity as potential mechanism of transfer and connection between the interbank market and liquidity in the equity market, there does not seem to exist a direct connection in the differences. Especially the significant correlations between the financing measures and risk management vanish. Solely changes in repo agreements with term maturity remain significantly associated with changes in risk management and exhibit almost the same coefficients as before. Then, repo and term repo financing remain significantly correlated with illiquidity. The significant association between tightness in the interbank market and volatility in the equity market also survives the first-differencing. Finally, changes in the financing activity at arbitrary maturity are no longer associated with changes in the state of the interbank market.

The analysis of correlations of levels and first differences provides a first indication of potential interaction effects between liquidity in the equity market and risk management in the interbanking sector. After taking the differencing, liquidity and risk management are positively and significantly correlated with each other. It seems also plausible to consider financing measures and variables capturing tightness in both markets as potential indicators that connect both markets.

5. Interaction of Risk Management Practices and Market Liquidity

5.1. Interaction between the Interbank Market and the Equity Market

Following the results of the correlation analyses, there are reasons to expect cross-market effects and bidirectional causalities between the interbank and equity market. For instance, if there arise lead and lag effects of tightness in the interbank market in response to a systematic risk effect or an information shock on the perceived level of risk, then these measures can be used to predict the scope of financing and thus the level of liquidity. Similarly, lead and lag effects of volatility in the equity market may affect interbank financing activity and have cross-effects on the risk management in the interbank as well as on the level of liquidity in the equity market. Thus, if shocks on risk and liquidity get reflected in one market before the other, then, exemplarily, adjustments in risk management in the interbank market determine changes of liquidity in the equity market.

Given that there are reasons to expect to observe these cross-market effects as well as bidirectional causalities, I first apply a vector autoregression model that incorporates the first difference of the variables under inspection. I specify the autoregression system in a way to evaluate the association for a pair of each of the different variables capturing either interbank risk, tightness in the interbank sector, liquidity and volatility in the stock market as well as financing variables split according to different term structures.

I consider the following linear vector autoregressive model (VAR):

$$\begin{bmatrix} X_{1\,t} \\ X_{2\,t} \end{bmatrix} = \begin{bmatrix} A_{1\,0} \\ A_{2\,0} \end{bmatrix} + \begin{bmatrix} A_{1\,1}(L) & A_{1\,2}(L) \\ A_{2\,1}(L) & A_{2\,2}(L) \end{bmatrix} \begin{bmatrix} X_{1\,t-1} \\ X_{2\,t-1} \end{bmatrix} + \begin{bmatrix} \epsilon_{1\,t} \\ \epsilon_{2\,t} \end{bmatrix} \tag{4}$$

where A_{i0} are parameters representing intercept terms, $A_{ij}(L)$ are polynomials in the lag operator L, $X_{1\,t}$ and $X_{2\,t}$ are vectors that represent interbank and equity market observations, and $\epsilon_{1,t}$ and $\epsilon_{2,t}$ are white noise disturbances. I choose the number of lags in model (4) based on the Akaike

Table IV
Overview Lags

This table provides an overview about the lags derived on basis of the Akaike information criterion, the Schwarz's Bayesian information criterion, and the Lütkepohl version of the information criteria to fit the vector autoregression model in Equation (4). ILLIQ stands for Amihud's illiquidity measure, VAR captures the perceived risk of the Primary Dealers, VIX measures volatility in the equity market, LIBOIS and TED capture the tightness in the interbank market. These data were equally averaged over one quarter and cover the time period between 1998Q4 and 2010Q1. NETFINANCING and NETREPO cover the financing activity of the interbank sector via securities lending or repo transactions; the suffixes T and O specify the maturity of the contract, where T stands for term and O determines overnight and continuing agreements, respectively.

	ILLIQ	VAR	VIX	LIBOIS	TED	NETFIN	NETFIN$_T$	NETFIN$_O$	NETREPO	NETREPO$_T$	NETREPO$_O$
ILLIQ		1	2	1	1	3	1	4	1	1	1
VAR	1		1	1	1	4	1	1	1	1	4
VIX	2	1		1	1	1	1	4	3	1	4
LIBOIS	1	1	1		4	4	1	4	3	1	4
TED	1	1	1	4		4	1	4	1	1	3
NETFIN	3	4	1	4	4		1	1	1	4	1
NETFIN$_T$	1	1	1	1	1	1		1	1	1	1
NETFIN$_O$	4	1	4	4	1	1	1		4	4	1
NETREPO	1	1	3	3	1	1	1	4		1	4
NETREPO$_T$	1	1	1	1	1	3	1	4	4		4
NETREPO$_O$	1	4	4	4	3	1	1	1	4	4	

information criterion, the Schwarz's Bayesian information criterion, and the Lütkepohl version of the information criteria. Where the three criteria indicate different lag lengths, I choose the shorter lag length for the sake of parsimony. In order to consider the fact that I work on quarterly averaged means, I allow up to four lags. Table IV provides an overview about the chosen lag length of the different VARs.

In Table V I present the results from pairwise VARs with eleven variables as endogenous factors and the lags choosen according to Table IV. Each VAR is estimated with a constant and is based on observations from 46 quarters. It is important to note that the cross-correlation analysis allows to incorporate time effects. Thus, no present interactions are evaluated - the subsequent cross-correlation analysis reveals lagged associations over time.

Panel A of Table V reports cross-correlations in innovations obtained from the VAR systems. The inspection reveals that there does not seem to exist any direct interaction of risk management and liquidity. However, both liquidity and risk management variables are again positively and strongly associated with interbank tightness. This supports the indication for a potential linkage of frictions in both markets as well as the existence of a common transfer mechanism that connects these markets.

Next, as the aggregated financing measure is associated with both liquidity and risk management, financing activity seems to connect both markets. Highly significant cross-correlations

indicate that risk management and the scope of financing activity in the interbank market are strongly associated. Additionally, aggregated financing variables are also strongly and positively cross-correlated with the prevailing level of liquidity.

This association also seems to be present in the interaction with liquidity in the equity market; however only on a lagged basis.

These findings allow to assume that there exist connections through transfer mechanisms. Thus, time lags arise from the interbank market and effects from this market appear delayed, transferred through financing mechanisms, in the equity market. This pattern can be observed from the cross-correlation of overnight financing activity with both, liquidity in the equity market and the level of risk management in the interbank market. Furthermore, this measure is also associated with volatility and tightness in the interbank market. Aggregated repo financing activity displays similar patterns. Financing measures, split according to the maturity of the agreement, are associated with measures for the tightness of their underlying, interbank, market as well as with measures of the state of the connected, equity market. This further bolsters support for a potential connection between both markets.

Interestingly, changes in repo financing activity are stronger and more significant related to tightness in the interbank market. This fact provides evidence that the interbank market primarily finances through repos that are stronger determined by tensions of participating banks face through their risk management.

To sum up the findings of the correlations analysis in levels and differences, and after considering lagged variables, it can be seen that the level of risk management in the interbank market and liquidity in the equity market are connected through lead and lag variables of interbank tightness and measures capturing volatility in the stock market. These variables seem to captured the extent of prevailing tightness in each underlying market, but are also affected by spill-over effects of the adjacent market. Financing activity is the a central mechanism that basically seems to connect liquidity and risk management.

In order to further investigate how these transfer mechanism work, I consider a causality approach that allows to incorporate leads and lag variables and assess their eligibility to predict developments of the variables. This approach also allows to incorporate and use that fact that differencing or lagging variables sometimes influences the sign of causation and therefore give an unclear picture about the scope of the real influence.

5.2. Mutual Dependence, Granger-causality

For the null hypothesis that variable i does not Granger-cause variable j, I test whether the lag coefficients of i are jointly zero when j is the dependent variable in the VAR. Granger (1969) defines causality between two scalar-valued, stationary, and ergodic time series $\{X_{1\,t}\}$ and $\{X_{2\,t}\}$ in the following way: Let $F(X_{1\,t}|\mathbf{I}_{t-1})$ be the conditional probability distribution of $X_{1\,t}$, given the bivariate information set $(\mathbf{I}_{t-1})$ consisting of an Lx_1-length lagged vector of $X_{1\,t}$, say $\mathbf{X}_{1\,t-Lx_1}^{Lx_1} \equiv (X_{1\,t-Lx_1}, X_{1\,t-Lx_1+1}, ..., X_{1\,t-1})$, and an L$x_2$-length lagged vector of $X_{2\,t}$, say $\mathbf{X}_{2\,t-Lx_2}^{Lx_2} \equiv (X_{2\,t-Lx_2}, X_{2\,t-Lx_2+1}, ..., X_{2\,t-1})$. Given the lags Lx_1 and Lx_2, the time series $\{X_{2\,t}\}$ does not strictly Granger-cause $\{X_{1\,t}\}$ if:

$$F(X_{1\,t}|\mathbf{I}_{t-1}) = F\left(X_{1\,t}|(\mathbf{I}_{t-1} - \mathbf{X}_{2\,t-Lx_2}^{Lx_2})\right), t = 1, 2, ... \tag{5}$$

If the equality in Equation (5) does not hold, then knowledge of past X_2 values helps to predict current and future X_1 values, and X_2 is said to strictly Granger-cause x_1. Similarly, a lack of instantaneous Granger-causality from x_2 to x_1 occurs if:

$$F(X_{1\,t}|\mathbf{I}_{t-1}) = F(X_{1\,t}|(\mathbf{I}_{t-1} + X_{2\,t})), \tag{6}$$

where the bivariate information set is modified to include the current value of X_2. If the equality in Equation (6) does not hold, then X_2 is said to instantaneously Granger-cause X_1.

As shown in Equations (5) and (6), strict Granger-causality relates the past of one time series to influence the present and future of another time series. This contrasts this approach from instantaneous causality, that relates the present of one time-series to influence the present of another time-series.

Panel B in Table V presents pairwise Granger-causality tests between the endogenous variables of the VAR. For the null hypothesis that variable i does not Granger-cause variable j, I test whether the lag coefficients of i are jointly zero, when j is the dependent variable in the VAR. In panel B of Table V the cells are associated with the i-th row variable and the j-th column variable shows the chi-square statistic of the test.

First, I observe the causal effects on liquidity in the equity market as endogenous variable. There arises strong evidence for a causal relation between the levels of liquidity and the perceived levels

Table V
Contemporaneous Cross-correlations between VAR Innovations and Granger Causality Tests

This table presents results from a VAR with endogenous variables, estimated with two lags and a constant term. It is based on 404 observations. Panel A shows the cross-correlations between VAR innovations. Panel B presents the Chi-square statistics of pairwise Granger-causality tests between endogenous variables. ILLIQ stands for Amihud's illiquidity measure, VAR captures the risk management of the Primary Dealers, VIX stands for the measure of volatility in the equity market, LIBOIS and TED measure the tightness in the interbank market. These data were equally averaged over one quarter and cover the time period between 1998Q4 and 2010Q1. NETFINANCING and NETREPO cover the financing activity of the interbank sector via securities lending or repo transactions; the suffixes T and O specify the maturity of the contract, where T stands for term and O determines overnight and continuing agreements, respectively. These financing data are available since July 4, 2001 and are summed up of the corresponding quarters.

	ILLIQ	VAR	VIX	LIBOIS	TED	NETFIN	$NETFIN_T$	$NETFIN_O$	NETREPO	$NETREPO_T$	$NETREPO_O$
Panel A: Cross-Correlations between VAR innovations											
ILLIQ	1.000										
VAR	0.013	1.000									
VIX	-0.336**	0.233	1.000								
LIBOIS	0.474***	0.315*	0.121	1.000							
TED	0.391***	0.423***	0.179	0.274	1.000						
NETFIN	0.611***	0.523***	0.046	0.293	0.189	1.000					
$NETFIN_T$	0.133	-0.142	0.045	0.050	0.062	-0.166	1.000				
$NETFIN_O$	0.474***	0.293*	0.513***	0.395**	-0.028	0.265	-0.023	1.000			
NETREPO	0.148	0.224	0.451**	0.506***	0.369**	0.314*	-0.076	0.513***	1.000		
$NETREPO_T$	0.114	-0.048	0.232	0.314*	0.429**	0.389**	0.041	0.596***	0.562***	1.000	
$NETREPO_O$	0.103	0.502***	0.420	0.314*	0.525***	0.265	-0.105	0.328*	-0.136	-0.440**	1.000
Panel B: Chi-square statistics from Granger causality tests. Null hypothesis: Row variable does not Granger-cause column variable											
ILLIQ		8.565***	16.278***	0.734	0.039	1.728	5.313**	13.743***	3.631*	8.275***	1.767
VAR	2.040		2.189	9.970***	16.819***	3.087	1.510	0.127	0.137	0.027	12.838**
VIX	19.797***	8.210***		1.150	3.493*	0.786	9.521***	10.818**	9.596**	13.993***	8.749*
LIBOIS	3.798*	10.653***	2.515		48.869***	0.910	12.526***	9.533**	4.714	13.994***	11.347**
TED	3.719*	19.668***	4.303**	72.889***		1.769	12.723***	14.685***	1.576	20.855***	6.908*
NETFIN	22.583***	39.756***	0.065	65.008***	38.334***		1.228	1.013	0.806	11.773**	0.038
$NETFIN_T$	2.368	0.942	0.079	0.160	0.201	0.978		1.013	0.889	11.461***	2.050
$NETFIN_O$	20.655***	3.925**	37.824***	54.058***	0.020	0.978	1.228		21.592***	30.725***	3.007*
NETREPO	3.962**	1.445	22.510***	22.535***	5.277**	2.098	0.225	24.774***		0.499	31.017***
$NETREPO_T$	6.177**	0.375	1.783	3.216*	7.275***	6.177	1.768	35.923***	22.788***		31.017***
$NETREPO_O$	0.860	25.970***	28.770***	36.660***	27.226***	3.236*	1.275	2.696	22.788***	11.166**	

*p<0.10,**p<0.05, ***p<0.01

of risk management, whereas levels of risk management does not seem to directly Granger-cause the levels of liquidity. However, there is evidence for a strong and significant two-way causation between liquidity and volatility in the equity market. Thus, innovations in liquidity are related to volatility that itself feeds back on prevailing levels of liquidity. Another strong natural two-way causation seems to exist between liquidity and overnight financing activity, repos and term repos. Furthermore, innovations in liquidity are Granger-caused by interbank tightness measures and aggregated financing activity.

Next, the inspection of the effects that determine the level of perceived interbank risk reveals a highly significant Granger-causation with the measures for equity market liquidity and volatility.

Furthermore financing variables Granger-cause the level of perceived risk, however only on an

aggregated and overnight and continuing basis. Additionally, there also exists a two-way Granger-causation between the level of perceived risk and interbank market tensions. This supports the idea that the level of perceived interbank risk is determined by interbank tightness measures, whereas effects of risk management also feed back on the interbank tightness. Further support arises from the mutual Granger-causation of risk management, and overnight and continuing repo financing.

As a first interim result, I conclude that liquidity seems to be directly associated with the level of perceived interbank risk, whereas the level of risk seems to drive liquidity through other channels that have to be evaluated in the subsequent analysis.

Thus, volatility seems to be significantly determined by financing activity and in this way by the available collateral for transactions. There arises a strong and significant mutual Granger-causation between volatility and almost all financing measures. This allows to consider volatility as one potential mechanism that connects both markets by driving the effects of financing to the equity market. Additionally, VIX and illiquidity innovations mutually Granger-cause each other, whereas volatility Granger-causes only with perceived risk.

The inspection of both interbank tightness measures reveals, that both tightness variables and risk management do mutually Granger-cause each other. This results seems to provide further support for the results of the (cross-)correlation analyses. Next, interbank tightness measures seem to be associated with volatility in the stock market as well as with corresponding financing activity. Especially, there seems to exist a strong association with repo financing activity that may be explained by the collateralized nature of these financing agreements. Finally, tightness in the interbank market also seems to be transmitted to liquidity in the equity market, whereas mutual Granger-causation cannot be found. Again, this supports the basic assumption that potential spill-over and connection mechanisms can be captured by market risk and financing measures. Thus, tightness in the interbank market seems to decisively determine and interact with the risk management measure.

Next, the financing measures provide a less clear-cut picture. Aggregated financing measures develop almost independently, that is, almost uncaused from the variables under inspection. However, contrary to this finding, almost all sample variables seem to Granger-cause aggregated financing. Thus, there arises highly significant Granger-causations between netfinancing measures and liquidity, the level of perceived risk and interbank tightness measures. This indicates that the financing measures are important to incorporate in the analysis, as they connect the developments in the

equity and interbank market and transfer the resulting effects between these markets.

The observation of financing activity segmented into different maturities reveals, that term financing agreements are Granger-caused by liquidity, volatility and interbank market risk; but do not Granger-cause other variables. Again, it is important to emphasize to connection to interbank tightness, market liquidity and financing activity.

In support of these findings, overnight financing seems to play the real role as transfer mechanism that connects the interbank and equity market. Overnight netfinancing activity mutually Granger-causes with liquidity and volatility in the equity market and with equity market tightness measures. Furthermore, overnight financing Granger-causes the level of perceived risk. This provides an indication that the inherent transfer effects of financing activity are captured the best by overnight netfinancing activity.

Aggregated repo financing activity actually provides a similar pattern than aggregated financing activity. Thus, there seem to occur mutual Granger-causations between liquidity and volatility in the equity market. Furthermore, netrepo financing activity Granger-causes tightness measures in the interbank market. Contrary to term financing activity, concerning term netrepo arrangements, there seem to occur enhanced interactions with illiquidity and interbank tightness measures. Thus, an even stronger Granger-causation seems to exist between overnight and continuing netrepo financing measures. Additionally, this measure mutually Granger-causes directly and highly significantly with risk management, interbank tightness, and volatility in the equity market.

This Granger-causation analysis reveals that risk management and liquidity are connected - however not directly mutually but through transfer mechanisms. Measure of tightness in the particular markets indicate a first response to corresponding changes. These indicator measures are partially affected by spill-over effects. However, the main mechanism that transfers shocks between the equity market and the risk management in the interbank market seems to be the financing activity of the Primary Dealers.

After having conducted the cross-correlation and Granger-causality analysis it is important to state that Granger-causality should not be interpreted according to the normal meaning of causality and exogeneity. Thus is would require for a variable to be considered as exogenous that it is not affected by contemporaneous values of the endogenous variable. However, Granger-causality refers only to the effects of past values of an endogenous variable to current values of the variable under inspection. Hence, Granger causality does not allow to draw real causality statements. For example,

there is no direct evidence for a mutual interaction of risk management and liquidity. However, the Granger test shows evidence for a mutual interaction of risk management with interbank tightness and overnight financing activity. Furthermore risk management interacts with illiquidity, volatility in the equity market and other financing measures. These influences of risk management on market liquidity are assumed to be subject to common influences, but changes one variable, do not "lead" directly to changes in the other market.

5.3. Shocks to the System, Impulse Responses

In order to further understand the dynamic interaction between liquidity and risk management, I compute impulse response functions (IRFs). An IRF allows to trace out the time path of a one unit change (henceforth "innovation" or "shock") on the variables contained in the VAR system. This method allows to capture the effect how a change in any of the exogenous variables is "transferred" to the current and future endogenous variables.

Since innovations are correlated (Table V, Panel B) they need to be orthogonalized. I apply the Cholesky decomposition to the residual covariance matrix in order to orthogonalize the impulses. In contrast to Granger-causality tests, results from IRFs and variance decompositions are generally sensitive to the specific ordering of the endogenous variables. In particular, placing a variable earlier in the ordering tends to increase its impact on the variables that follow. Thus, in choosing an ordering, one approach is to order the variables according to the sequence in which they influence the other variables.

Based on the (cross-)correlations and Granger-causality analysis above, I consider the following order of market determinants: (1) Measures for interbank tightness follow onto perceived levels of risk. Thus, I assume that in situations of a perceived change in the risk environment, financial institutions react by becoming more sensitive to market developments and respond by adjusting their lending activities. This adoption is reflected in adjustments of the interbank lending rate. (3) Since measures for interbank tightness are derived directly from interbank lending rates, these measures are affected next. As featured in the cross-correlations analysis, interbank tightness measures are associated and Granger-caused by interbank financing. Hence, adjustments in the interbank lending rate influence the level of available collateral for financing transactions. Succeeding these adjustments in the lending activity, interbank tightness is assumed to spill over to the equity market. (4) Interbank financing activity is related with the state of the equity market, captured by volatility.

(5) Finally, changes in volatility are associated with liquidity as both measures are determined by changes in volatility and the level of available funding.

5.3.1. Impulse Response Function Specification

In order to consider the fact that the financing activity of Primary Dealers is available as aggregated measures (*NETFIN* and *NETREPO*) as well as split according to the maturity of the agreement (*Term Maturity*, and *Overnight and Continuing*), four different models are specified.

Basically, all models are based on the same ordering, as describe above, and vary only in the kind of financing activity and in maturity, respectively. I ensure that all VARs are stationary by checking that the eigenvalues of the compansion matrix of the VAR are inside the unit circle. Thus, the maximum lag length is limited to two quarters.

Model 1: Aggregated Netfinancing:

$$\begin{bmatrix} VAR_t \\ TED_t \\ NETFIN_t \\ VIX_t \\ ILLIQ_t \end{bmatrix} = \begin{bmatrix} A_{1\,0} \\ \cdot \\ \cdot \\ \cdot \\ A_{5\,0} \end{bmatrix} + \begin{bmatrix} A_{1\,1}(L) & \cdot & \cdot & \cdot & A_{1\,5}(L) \\ \cdot & \cdot & & & \cdot \\ \cdot & & \cdot & & \cdot \\ \cdot & & & \cdot & \cdot \\ A_{1\,5}(L) & \cdot & \cdot & \cdot & A_{5\,5}(L) \end{bmatrix} \begin{bmatrix} VAR_{t-1} \\ TED_{t-1} \\ NETFIN_{t-1} \\ VIX_{t-1} \\ ILLIQ_{t-1} \end{bmatrix} + \begin{bmatrix} \epsilon_{1\,t} \\ \cdot \\ \cdot \\ \cdot \\ \epsilon_{5\,t} \end{bmatrix} \quad (7)$$

Model 2: Netfinancing, Maturity:

$$\begin{bmatrix} VAR_t \\ TED_t \\ NETFIN_{T,t} \\ NETFIN_{O,t} \\ VIX_t \\ ILLIQ_t \end{bmatrix} = \begin{bmatrix} A_{1\,0} \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ A_{6\,0} \end{bmatrix} + \begin{bmatrix} A_{1\,1}(L) & \cdot & \cdot & \cdot & \cdot & A_{1\,6}(L) \\ \cdot & \cdot & & & & \cdot \\ \cdot & & \cdot & & & \cdot \\ \cdot & & & \cdot & & \cdot \\ \cdot & & & & \cdot & \cdot \\ A_{1\,6}(L) & \cdot & \cdot & \cdot & \cdot & A_{6\,6}(L) \end{bmatrix} \begin{bmatrix} VAR_{t-1} \\ TED_{t-1} \\ NETFIN_{T,\,t-1} \\ NETFIN_{O,\,t-1} \\ VIX_{t-1} \\ ILLIQ_{t-1} \end{bmatrix} + \begin{bmatrix} \epsilon_{1\,t} \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \epsilon_{6\,t} \end{bmatrix} \quad (8)$$

Model 3: Aggregated Repo Financing:

$$\begin{bmatrix} VAR_t \\ TED_t \\ NETREPO_t \\ VIX_t \\ ILLIQ_t \end{bmatrix} = \begin{bmatrix} A_{1\,0} \\ \cdot \\ \cdot \\ \cdot \\ A_{5\,0} \end{bmatrix} + \begin{bmatrix} A_{1\,1}(L) & \cdot & \cdot & \cdot & A_{1\,5}(L) \\ \cdot & \cdot & & & \cdot \\ \cdot & & \cdot & & \cdot \\ \cdot & & & \cdot & \cdot \\ A_{1\,5}(L) & \cdot & \cdot & \cdot & A_{5\,5}(L) \end{bmatrix} \begin{bmatrix} VAR_{t-1} \\ TED_{t-1} \\ NETREPO_{t-1} \\ VIX_{t-1} \\ ILLIQ_{t-1} \end{bmatrix} + \begin{bmatrix} \epsilon_{1\,t} \\ \cdot \\ \cdot \\ \cdot \\ \epsilon_{5\,t} \end{bmatrix} \quad (9)$$

Model 4: Repo Financing, Maturity:

$$\begin{bmatrix} VAR_t \\ TED_t \\ NETREPO_{T,t} \\ NETREPO_{O,t} \\ VIX_t \\ ILLIQ_t \end{bmatrix} = \begin{bmatrix} A_{1\,0} \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ A_{6\,0} \end{bmatrix} + \begin{bmatrix} A_{1\,1}(L) & \cdot & \cdot & \cdot & \cdot & A_{1\,6}(L) \\ \cdot & \cdot & & & & \cdot \\ \cdot & & \cdot & & & \cdot \\ \cdot & & & \cdot & & \cdot \\ \cdot & & & & \cdot & \cdot \\ A_{1\,6}(L) & \cdot & \cdot & \cdot & \cdot & A_{6\,6}(L) \end{bmatrix} \begin{bmatrix} VAR_{t-1} \\ TED_{t-1} \\ NETREPO_{T,\,t-1} \\ NETREPO_{O,\,t-1} \\ VIX_{t-1} \\ ILLIQ_{t-1} \end{bmatrix} + \begin{bmatrix} \epsilon_{1\,t} \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \epsilon_{6\,t} \end{bmatrix} \quad (10)$$

where A_{i0} are parameters representing intercept terms, $A_{ij}(L)$ are polynomials in the lag operator L, and ϵ_{it} are white noise disturbances.

5.3.2. Direct Influence of Risk Management on Liquidity

I first assess the direct interaction of risk management in the interbank market and liquidity in the equity market. This analysis is conducted under the implicit assumption that the above derived potential transfer mechanisms prevail and interact with each other. Thus, these mechanisms drive the considered interaction with interbank and equity markets measures through the system of autoregressions.

Figure 2 illustrates the response of liquidity to a one unit shock on the risk management variable. I evaluate the direct reaction of liquidity for the above mentioned four model specifications. The implications of the correlation, cross-correlation and Granger-causality analysis are, at least, partially confirmed.

Thus, in an immediate response to a shock to perceived risk in the interbank market, illiquidity in the equity market increases. This reaction is independent of the model specifications. However, subsequently onto the immediate shock, illiquidity in the equity market relaxes again and liquidity increases. This increase of liquidity indicates a surge in deleveraging transactions due to increased risk positions and heightened margin requirements. These deleveraging transactions last for two periods. Then, two quarters after the initial introduction of the shock into the system, illiquidity increases again, but from a lower level than before. Thus, the initial market reaction is terminated and existing positions that were considered as too hazardous under the new risk assessment were unwinded. Further, due to reduced availability of collateral in combination with limited risk-

bearing capacity in the interbank sector, transactions in the equity market are limited or even cancelled. After that, illiquidity increases again. However it does not turn back to its initial level before the system was shocked. Indeed, it "over-shoots" beyond its initial level. Then, three periods after the original introduction of the shock into the system, illiquidity in the equity market reaches its second peak. Again, market participants realize an imbalance between their positions and the targeted levels determined by risk management constraints. Consequently, deleveraging transaction occur and tighten liquidity once again. Finally, the level of liquidity "meanders" back to its initial level after seven quarters. The size of this counteraction depends strongly on the VAR model specifications and exhibits almost the same scope as the initial risk management shock had (Figure 2, Model M1).

This first results support the main hypothesis that risk management in the interbank sector has decisive influence on the level of liquidity in the equity market. Actually there seems to occur potential interaction effects.

5.3.3. Direct Influence of Liquidity on Risk Management

In this section the effects of a one unit innovation of liquidity on the perceived level of risk in the interbank sector are evaluated. Figure 3 illustrates the effects of a one unit shock in illiquidity on risk management through the autoregression model specifications. In contrast to the previous transfer of shocks there arises no direct impact on risk management. Perceived risk in the interbank sector features a prolonged reaction and reaches its reaction peak after two quarters (Figure 3, Model M1 and Model M2) or after one lagged period (Figure 3, Model M3 and Model M4). However, the reaction is the same for all model specifications: Liquidity in the equity market interacts with the perceived level of risk in the interbank market. A one unit increase in liquidity comes along with an increase in the variable capturing perceived interbank risk.

This effect can be explained by a reduction in trading due to decreased availability of collateral. Thus, when interbank market participants enter into a financing transaction they incorporate not only the prevailing conditions, they also consider the environment at the time when unwinding the position. As previously seen, liquidity massively determines this environment and in this way the ease of unwinding positions. Then, as illiquidity increases interbank dealers face soared tightness to unwind existing positions and, subsequently, the perceived level of risk on existing positions increases.

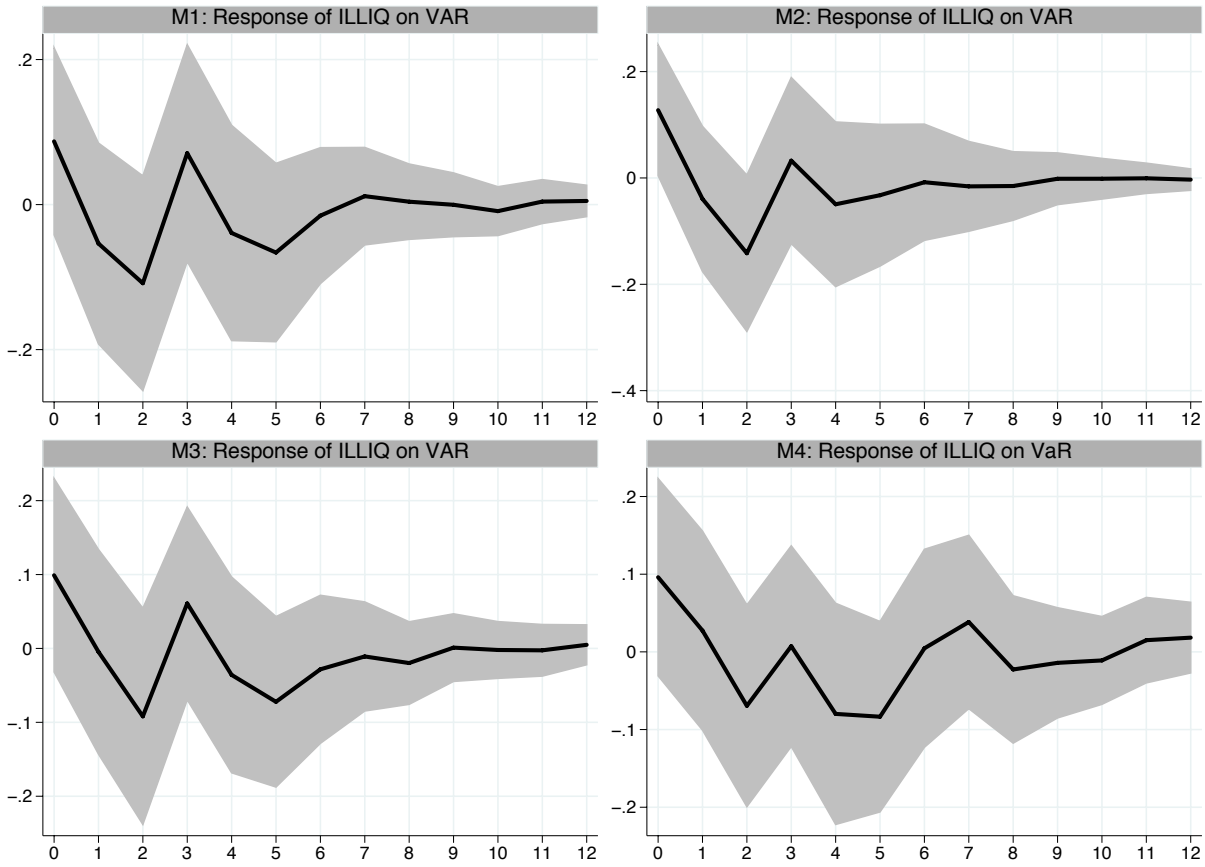

Figure 2. Orthogonalized impulse-response functions of illiquidity. This chart plots the orthogonalized impulse-response function of illiquidity (ILLIQ) on a one unit shock of the perceived interbank risk (VAR). M1-M4 specify the underlying vector autoregression model specification. The grey shaded area indicates the 95% confidence interval for a forecasting period of 12 quarters.

As the liquidity driven raise in perceived risk drives interbank dealers to force their counterparties to unwind positions, the above described deleveraging effects occur. This implies that existing positions become unwinded and in line with reduced exposure, perceived risk of the interbank dealers declines. However, in dependence of the underlying model specification, this phase of easing lasts between three and five quarters.

Next, after the deleveraging transactions become settled, perceived levels of risk increase again. Thus, as liquidity is incorporated in the methods for risk-assessment, reduced trading activity begins to feed back into risk calculations. Consequently, VaR positions begin to raise again. Additionally, reduced amounts of collateral and tightened funding conditions lead to auxiliary feedback effects. Finally a process of assimilation follows until the original stable levels are reached. Hence, it can

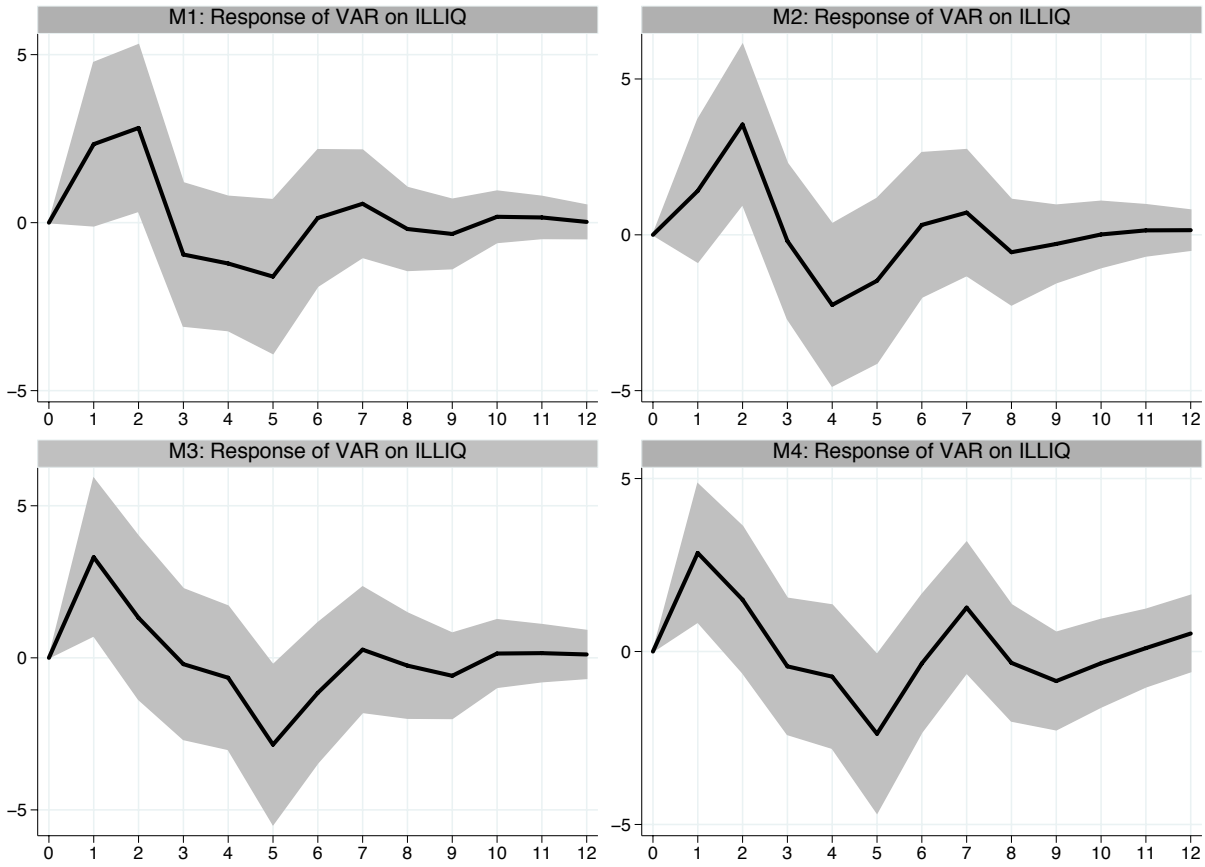

Figure 3. Orthogonalized impulse-response functions of interbank market risk. This chart plots the orthogonalized impulse-response function of perceived Primary Dealer risk (VAR) on a one unit shock of illiquidity (ILLIQ). M1-M4 specify the underlying vector autoregression model specification. The grey shaded area indicates the 95% confidence interval for a forecasting period of 12 quarters.

be concluded that liquidity and risk management mutually interact and influence each other.

5.3.4. Interaction between Risk Management and Market Variables

After analysing the direct interaction of risk management and liquidity variables, it is of further interest to observe the effects of risk management and liquidity on the other potential interaction variables. In the subsequent analysis all the results and insights derived from the previous analyses are incorporated.

Figure 4 illustrates the orthogonalized impulse-response functions of interbank, equity market and financing variables to a one unit shock on the perceived level of risk of the Primary Dealers. An inspection of all responses reveals that there occur several interaction effects.

A one unit increase in perceived interbank risk immediately increases tightness in the interbank market. Hence, in situations when interbank dealers face tightenings in the perceived risk environment, they respond directly by adjusting the price for lending. That is, they increase corresponding interest rates of financing transactions. As interbank tightness is defined by the difference in interest rates between secured and unsecured lending, this variable is affected in the first place. This immediate reaction is further associated with a reduction in financing activity. Following the correlations analyses above, these effects are connected and increases in risk management come along with reductions in financing. Thus, financing measures (*NETFIN* and *NETREPO*) decrease immediately in response to an increase in perceived risk. After one period, tightness in the interbank market mitigates massively. When the first run effects of unwinding of existing positions, that were not adequate according to the new risk environment, are settled, lending rates begin to ease. However, as financing capacity is still reduced, the limited scope of transactions evoke a secondary effect and interbank tightness increases again. Then, after a second period of deleveraging-transactions, interbank tightness levels off to the original level before the initial shock.

Next, volatility in the equity market displays almost the same pattern. The level of volatility increases quickly in response to changes in perceived interbank risk. After a massive rebound, a period of easing follows and volatility moves back to its initial level. This pattern seem to be mainly driven by liquidity-induced effects of risk management. Hence, the increase in risk leads to massive deleveraging transactions that increase - in an initial effect - the transactions and the amount of collateral in the market. As mentioned in the subsection above, liquidity increases in a first response to a surge in perceived risk. After these risk-induced transactions are terminated, the scope of available securities as collateral is reduced. Then, the reduced scope of trading activity in association with a reduced scope of collateral leads to an increase in illiquidity. However, the arising counter reaction is not that tight and the systems finds back to its initial level after an adjustment period of six quarters.

Aggregated financing measures support this evaluation: A massive decrease in these measures is followed by further tightening and a quick recovery after the initial shock. However, the inspection of financing activity split into different maturities reveals more interesting results. Hence, the reaction of short-term interbank financing emerges as the most vivid of the measure for overnight and continuing financing activity: An increase in risk management leads to a massive decline in financing activity. The impulse-response function and the effects of the analysis above provide

evidence for a strong connection between overnight financing activity and volatility in the equity market. Overnight financing activity takes three quarters to recover to its initial level and this reaction goes along with tightness in the equity market(volatility).

In order to interpret the effects of term financing activity, it is important to incorporate the pattern found in the summary statistics. Thus, Primary Dealers purchase on average more securities on a term basis. Hence, deleveraging effects in response to increased interbank tightness occur as well. However, the direction is vice verse: An increase in the term financing measure indicates that there are more securities reported as outgoing than there are reported as incoming. This implies that Primary Dealers buy back borrowed securities and reduce funding in this way. However, due to the face that financing measures are only reported on an aggregated basis, it is not definitely clear which effects dominates. Thus, there can be more securities reported as out going because of unwinding positions, or there can be less securities reported as in going due to reduced demand for financing in reaction of the effects in the overnight and continuing financing.

Finally, it is remarkable that aggregated financing and repo measures only return to their initial levels and do not anticipate the counteraction in the same intensity as the market-based measures do. Overnight and continuing financing measures are hit more by the innovations in risk management.

5.3.5. Interaction between Liquidity and Market Variables

Figure 5 presents the orthogonalized impulse-response functions of interbank, equity market and financing variables on a shock to liquidity in the equity market.

Interbank tightness increases in response to heightened illiquidity in the equity market. The reaction on reduced liquidity is even more distinctive in the equity market. There, volatility increases with almost the same scope than in response to a shock in perceived risk. Thus, in the further response to the liquidity-induced shock, both tightness measures exhibit a common pattern: After a peak, deleveraging transactions occur that alleviate the pressure in both markets. Obviously the first-response peak is more pronounced in the equity market as this market is affected by the original shock first.

This pattern seems to arise because interbank dealers realize a reduction in trading volume that increases illiquidity. As liquidity is one of the factors that determine lending conditions, the interbank dealers adjust the corresponding margins and their counterparties hit their adjusted

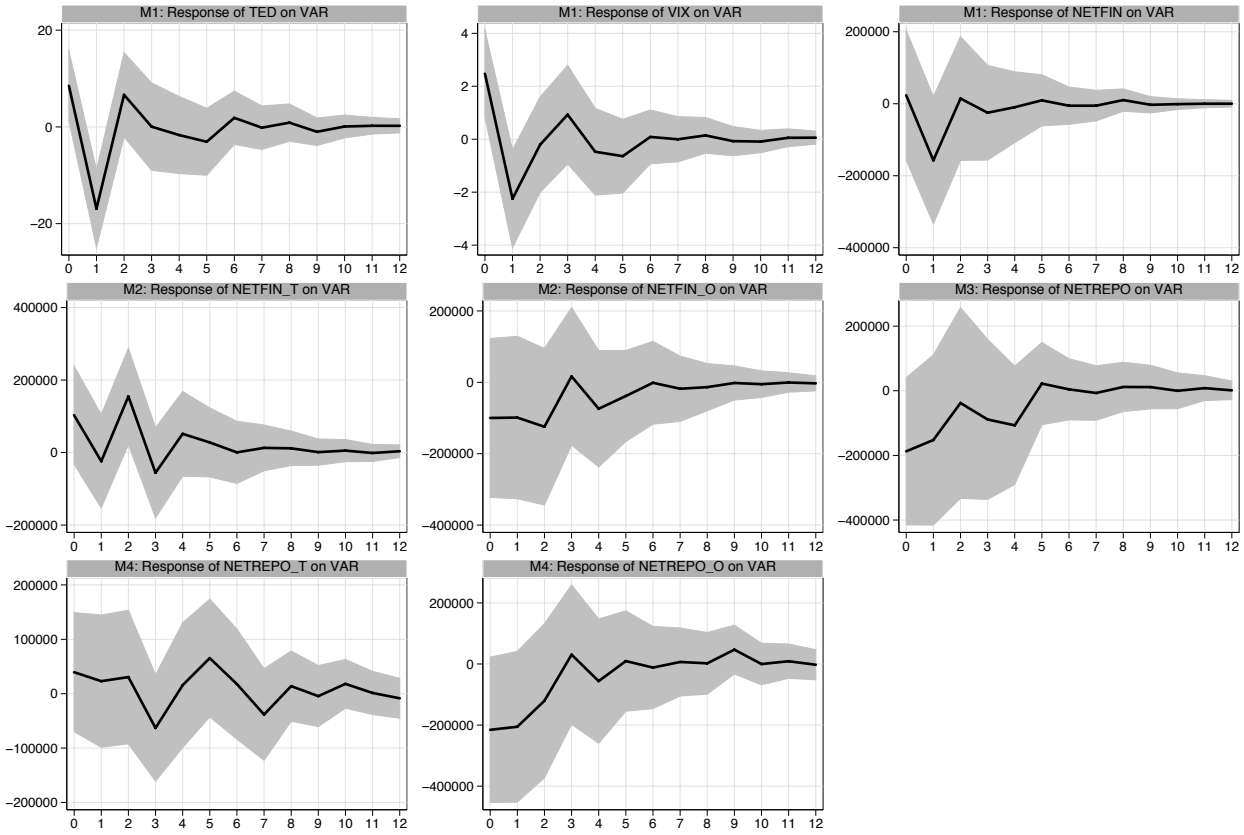

Figure 4. Orthogonalized impulse-response functions of interbank and equity market variables shocked by perceived interbank market risk. This chart plots the orthogonalized impulse-response functions of interbank market, equity market and financing variables on a shock of the perceived interbank risk of Primary Dealers. TED denotes the TED spread as measure for the tightness in the interbank market, VIX describes the VIX index that measures volatility in the equity market, NETFIN and NETREPO cover the financing activity of the interbank sector via securities lending and repo transactions, respectively; the suffixes T and O specify the maturity of the contract, where T stands for term and O determines overnight and continuing agreements, respectively. The grey shaded area indicates the 95% confidence interval for a forecasting period of 12 quarters.

margins. Subsequently, deleveraging transactions occur and the interbank dealers become, under the tightened liquidity situation, even more reluctant to finance or extend positions. Then, in response to increased illiquidity in association with deleveraging transactions, interest rates for lending increase. These lending rates are directly connected with the interbank tightness measures. Then, after one period the deleveraging transactions are settled, and tightness in both markets eases and reaches the original level after one period. Finally, the period of relaxation goes that far that both tightness measures ease even further - even above the original level before the introduction of the illiquidity shock. That "over-reaction" connects to netfinancing and net repo financing activity.

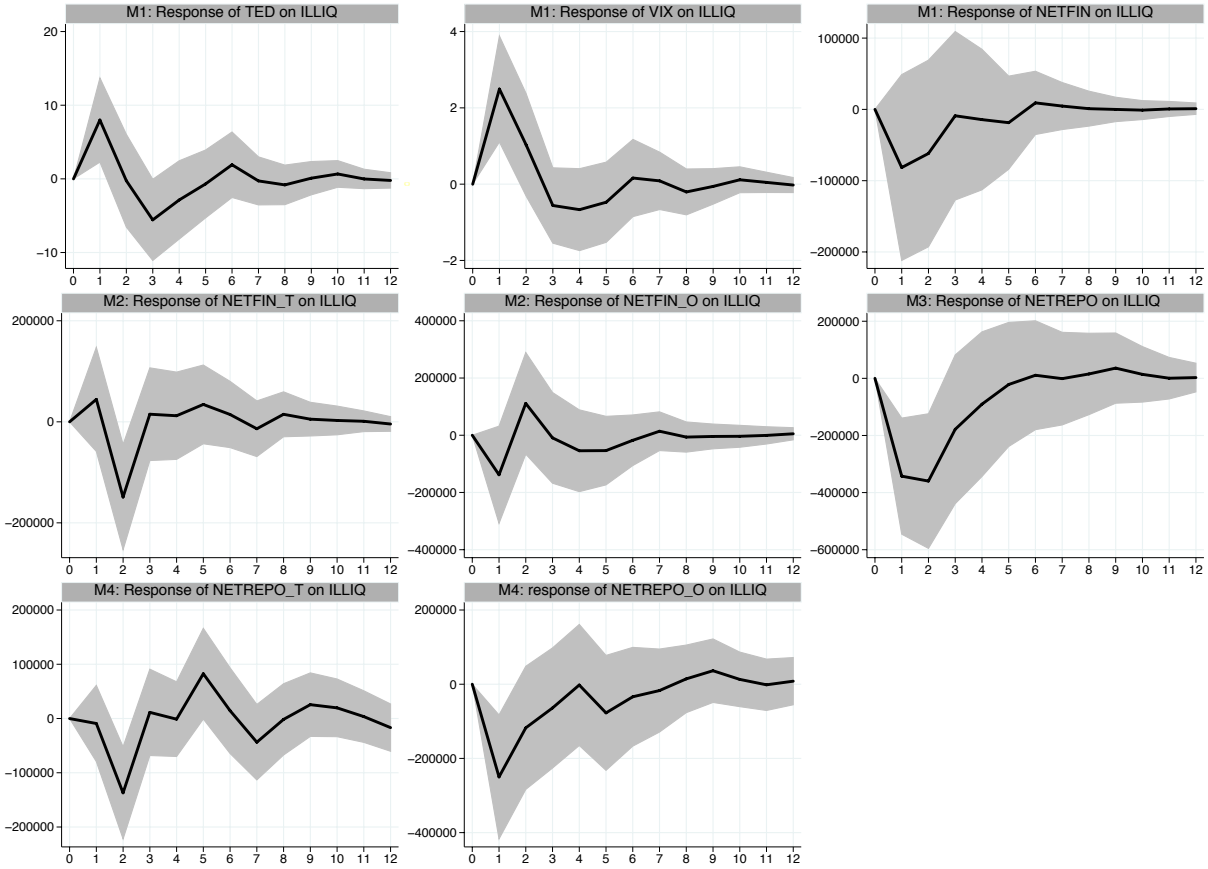

Figure 5. Orthogonalized impulse-response functions of interbank and equity market variables shocked by illiquidity in the interbank market This chart plots the orthogonalized impulse-response functions of interbank market, equity market and financing variables on a shock of the illiquidity in the equity market. TED denotes the TED spread as measure for the tightness in the interbank market, VIX describes the VIX index that measures volatility in the equity market, NETFIN and NETREPO cover the financing activity of the interbank sector via securities lending and repo transactions, respectively; the suffixes T and O specify the maturity of the financing activity, where T stands for term and O determines overnight and continuing agreements, respectively. The grey shaded area indicates the 95% confidence interval for a forecasting period of 12 quarters.

After a slump in financing volume because of increased illiquidity and feedback effects due to tightened risk management, both aggregate measures recover to reach their initial level before the shock.

6. Conclusions

This is one of the first papers that empirically combines risk management in the interbank sector and market variables in the general equity market. Examining a comprehensive dataset of hand-collected Primary Dealer risk management observations reveals as central finding the existence of cross-market effects and bidirectional causalities between the interbank and equity market. By considering the sample of Primary Dealers as representatives of the interbank market, I show that the perceived level of risk in the interbank market and the level of liquidity in the equity market seem to be associated through lead and lag effects.

The financing activity of the interbanking sector seems to be the primary transfer mechanism that connects both markets and drives potential adoptions between both markets. Through this connection, feedback effects arise that can result in mutually reinforcing effects. Measures for tightness in the interbank market and volatility in the equity market arise as potential indicators for transfers between both markets.

The level of perceived risk in the interbank market seems to be directly associated with changes in the level of liquidity in the equity market that Primary Dealers observe. Contrary to this, risk management in the interbanking sector does not seem to directly interact with liquidity in the equity market. The Granger-causality analysis reveals that primarily interbank tightness and volatility seem to determine the level of perceived risk in the interbank sector. More specifically, interbank dealers' financing activity decreases in response to an decrease in the perceived level of liquidity in the equity market. Hence, interbank dealers anticipate an increase in the inherent risk of their funding positions due to a decrease in liquidity. They react according to their risk management constraints and unwind existing positions. The inspection of the impulse-response functions reveals these deleveraging transactions as well as a concomitant effects in both markets. Thus, both volatility and interbank market tightness increase and both measures feed back on the perceived level of risk. These effect result in secondary adjustment mechanisms. Hence, after first-run deleveraging transaction become settled, heightened volatility and interbank tightness lead to further decreasing levels in liquidity, that in turn feed back on increasing levels of perceived risk.

Finally, the inspection of the impulse-response functions reveals the potential, that both, the liquidity and the risk management effect, can mutually influence each other. Thus, shocks in one market seem to spill-over to the other market leading to reinforcing feedback effect that result in

an even larger aggregate effect than the actual shock. These self-reinforcing feedback effects can leads to contagion effects, where shocks to equity market spill-over to the interbank market that itself feeds back on the equity market.

The inclusion of this additional risk management spiral into the liquidity spiral framework of Brunnermeier and Pedersen (2008) lets the contribution of this paper become apparent. Thus, the empirical evidence of an auxiliary spiral effect improves their models and helps to increase the prediction efficiency.

My analysis still presents some limitations. The VaR-filings of the Primary Dealers with the SEC, that are considered to capture the levels of perceived risk, are only available on an aggregated basis at the end of each filing quarter. Consequently, this implies that all liquidity and market tightness measures have to be aggregated to quarterly measures; although these observations are available on an even higher frequency. This implies a certain simplification and further research should attempt to evaluate VaR-filing at higher frequency. Furthermore, VaR-filing with the SEC are of high importance from a regulatory point of view. Thus, there are reasons to assume that the group of Primary Dealers aspires to report some kind of smoothed measures at the end of each quarter. Thereof occur possible distortions on these measures. Therefore, although being strictly private information, further research should to real daily VaR observation of interbank dealers. Then, the inspected financing data are only available on an aggregated basis for the group of Primary Dealers that report to the NY FED. Ideally, it would increase the precision of the analysis to have the real dealers financing data. Finally, one major improvement in this analysis would be to evaluate more detailed data about the margins and financing conditions that Primary Dealers set in their financing transactions. Thus, the effects of risk assessment and associated financing activity become more capturable.

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Table A.1
Overview Reporting Institutions

This table presents an overview of the filings of the individual institutions included into this study according to the quarter of filing.

Panel B: Reporting Institutions

	1998	1999				2000				2001				2002				2003				2004				2005				2006				2007				2008				2009				2010	Total
Reporting Quarter	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1		
BANK OF AMERICA CORP			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	43
BANK ONE CORP		x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x																								20
BEAR STEARNS COMPANIE	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x							37
CHASE MANHATTAN CORP		x	x	x	x	x	x	x																																				7
CITIGROUP INC																		x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x		x	x	x	x	x	x	x	27
CREDIT SUISSE (USA)									x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x													21
DONALDSON LUFKIN & JENRETTE	x	x	x	x	x	x	x	x																																				8
GOLDMAN SACHS GROUP									x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	38
HSBC USA INC									x		x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x		x	x	x	33
J P MORGAN CHASE									x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x		x		36
JEFFERIES GROUP INC																																						x	x	x	x	x			5
LEHMAN BROTHERS INC	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x							37
MERRILL LYNCH & CO IN	x			x					x	x	x	x	x	x		x	x		x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x					31
MORGAN STANLEY	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	44
SALOMON SMITH BARNEY	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x																													17
Total	6	6	7	8	9	8	8	6	11	9	10	10	10	11	10	11	10	9	11	11	11	11	10	10	10	9	10	10	9	10	10	10	8	9	9	9	7	9	7	8	5	7	7	7	5	6	404

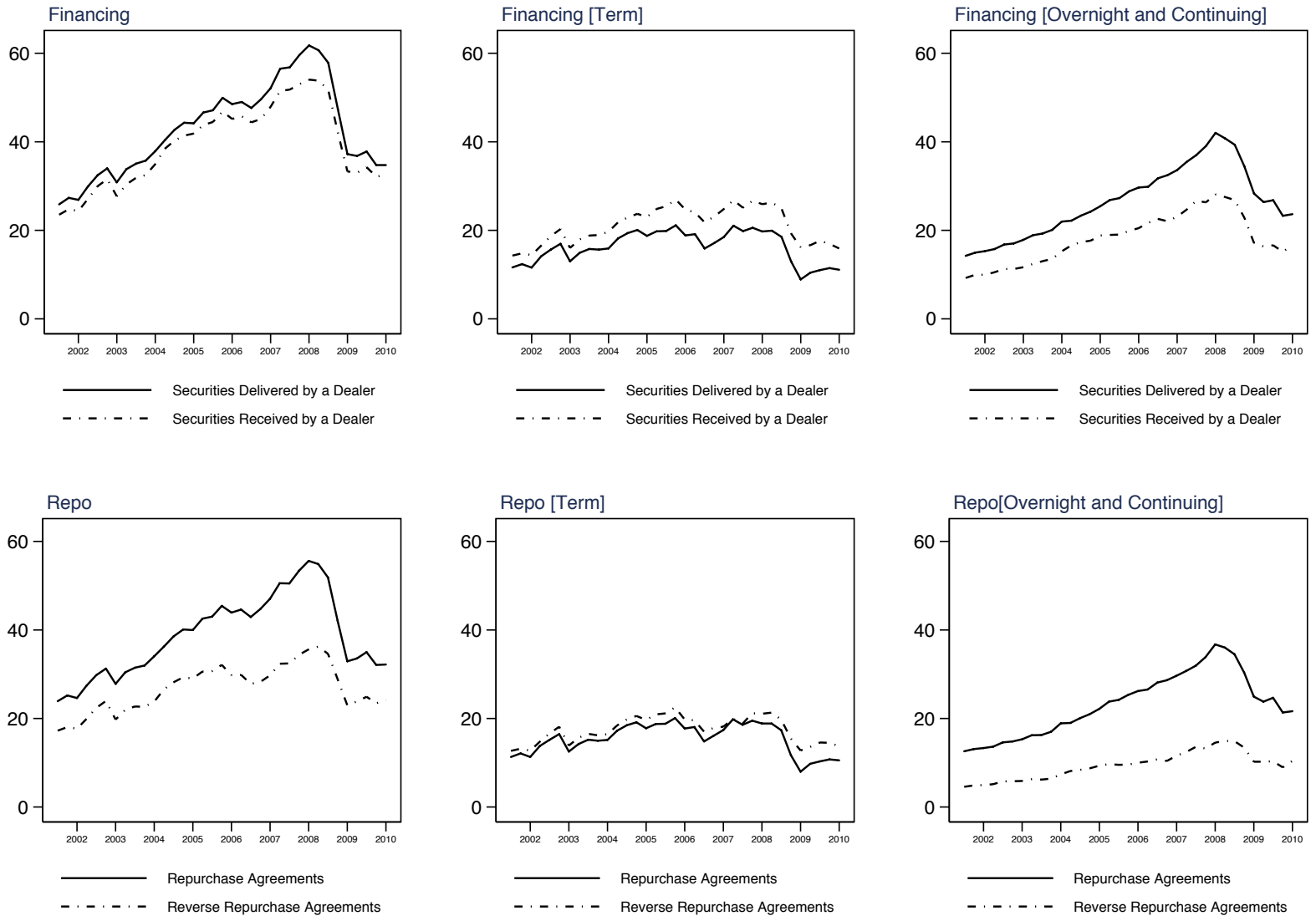

Figure A.2. Primary Dealer financing activity. This figure plots the amount of Primary Dealer financing activity. Both plots in the first column report the amount of financing on an aggregated basis, and the following charts depict financing data split according to the maturity of the agreement into term and overnight and continuing contracts, respectively. The differences between the securities that are delivered by a dealer in a transaction and the securities that are received by a dealer are considered as the netfinancing and netrepo activity, respectively. The figures are reported in USD 100 million.

Net New Money Flows of Swiss Private Banks

Urs W. Birchler, Daniel Ettlin, Michael R. Reichenecker, and Alexander F. Wagner*

OCTOBER 30, 2012

27% of the world's offshore assets are managed by Swiss banks, making understanding the determinants of the (changes of) assets under management an important (but so far neglected) area of research. Employing a unique dataset on net new money (NNM) flows of Swiss private banks, we document significant variation in the ability of banks to attract new funds. Private banks that had a negative media appearance in one year experience lower flows in the following year, suggesting that clients worry about the reputation of a bank. Perhaps surprisingly, banks with strong equity capitalization obtain less NNM, a result that is probably due to unobserved factors driving both leverage and client acquisition styles. More cost-efficient private banks obtain more NNM. We also establish that there are important differences in effects across banks (in particular in terms of bank size) and across time (before and after the 2007/08 crisis).

JEL-classification: G21

Keywords: Private banking, net new money, trust, wealth management

* Birchler: University of Zurich, Department of Banking and Finance, email: urs.birchler@bf.uzh.ch; Ettlin: University of Zurich, Department of Banking and Finance, email: daniel.ettlin@bf.uzh.ch; Reichenecker: University of Zurich, Department of Banking and Finance, email: michael.reichenecker@bf.uzh.ch; Wagner: University of Zurich, Harvard University and CEPR, email: alexander.wagner@bf.uzh.ch. Mailing address for all authors: University of Zurich, Department of Banking and Finance, Plattenstrasse 14, CH-8032 Zurich, Switzerland.

1 Introduction

In this paper we use a unique, hand-collected dataset to investigate net new money flows into and out of assets under management of Swiss private banks. *Private banking* refers to the part of the business field or banking unit that services wealthy individuals (Cocca (2008), Horn and Rudolf (2012)).[1]

There are several reasons to be interested in the ability of Swiss private banks to attract client money. First, the Swiss private banking sector presents one of the most important wealth management centers in the world. At the end of the year 2011 banks operating in Switzerland had CHF 5'300 billion assets under management, which represents a market share of 27% in cross-border private banking (Swiss Bankers Association (2012)). Understanding net new money flows for the Swiss case thus is of significant interest to policy makers and practitioners worldwide.

Second, the Swiss financial sector holds an important role for the Swiss economy; in 2011 it accounts for more than 10 percent of value added in Switzerland (Swiss Bankers Association (2011)). After decades of prosperity, this sector is currently facing substantial external pressure and the competition with other financial offshore centers intensifies. Erosions in the banking secrecy in Switzerland and tax amnesties in Germany, UK and Italy are leading to increasing repatriation of offshore assets. These developments are further augmented through regulatory pressure and increasing restructuring requirement of foreign owned banking subsidiaries. In the face of this new, difficult climate it is important to know what factors allow banks to position themselves well.

Third, in financial markets in general trust and discretion, service, and performance are very important. These qualities are especially highly valued in private banking. Studying this segment is, therefore, of significant interest as the role of these features is likely to be particularly pronounced here. At the

[1] In particular, the term "private banks" here refers to financial institutions focusing on wealth management and private banking. This is different from the term "private banker," which refers to the partner in a private bank that is organized as an unlimited partnership. The term "private bank" is also not intended to distinguish between privately held institutions and state-owned banks.

same time, private banking is a very specific area of the banking business that exhibits structurally different patterns than the general banking business.

For private banks, the source of value creation derives from their assets under management. Thus, to boost revenues banks can either increase the asset base or raise the margins earned on assets, or both. We focus on the developments of the asset base, considering the ability to keep existing funds as well as to increase the share of wallet of existing clients and to attract new funds as being the main strategic focus of banks (Simonian (2011), Maude (2006)).

Net new money (NNM) measures these factors. More precisely, net new money captures the net change of assets under management during a specific period and comprises the net amount of assets from new and existing clients less the amount of those clients who withdraw funds or terminate their relationship with a specific institution. Thus, NNM figures characterize the organic growth of the asset base of a bank in isolation of currency fluctuations, market performance, and interest and dividend payments.

Swiss banking is known for its discretion. However, strikingly, Switzerland is the only major country in the world that requires its banks to disclose, in the annual report, net new money flows. This study capitalizes on this information, which has so far been rarely used in academic research. Drawing on work conducted by Birchler et al. (2011), we construct the most comprehensive database of assets under management and net flows of Swiss private banks available to date. The more than 80 wealth management institutions in our sample manage an aggregated sum of more than CHF 4'000 billion of assets under management; this corresponds to around two thirds of total managed assets in Switzerland. We also include wealth management institutions in Liechtenstein as they are closely related to the Swiss market. In sum, we are able to provide a comprehensive picture of the broadly defined Swiss financial center.

We first document substantial cross-sectional and time-series variation in NNM flows. While the average NNM flow is around 4 percent of the total assets base, the standard deviation is 11 percent. Outflows of assets under

management reach up to CHF 2.5 billion, while the maximum inflow in a year was CHF 19.8 billion. This corresponds to a decrease of 20 percent and an increase of 30 percent in assets, respectively.

This heterogeneity then prompts us to investigate several hypotheses regarding the determinants of these flows, especially in the cross section. These hypotheses are motivated by the idea, so far evidenced mostly anecdotally, that private banking is a relationship-driven business that is based on the central pillars confidentiality, security, trust and the perceived level of client advisory service. We document several interesting results, including the following four:

First, Swiss private banks that had a negative media appearance in one year experience lower NNM flows in the following year, suggesting that clients worry about the reputation of a bank. *Second*, private banks with higher equity ratios achieve slower growth in assets under management in the following year. While this may be at first surprising, this result may indicate that these banks generally follow a more conservative business model and are less aggressive in chasing potential new clients. *Third*, private banks that offer a higher level of service and that are more cost-efficient obtain more NNM. *Fourth*, we also find cross-sectional and time-series heterogeneity in the importance of determinants. For example, it is small banks whose net new money flows are particularly strongly related to negative media coverage, and performance in terms of client value created was important only up to the 2007/08 crisis.

A search for literature on investigation of private banking industry in general and for studies with a focus on Switzerland in particular reveals that exists only very limited empirical research on private banking. This is surprising, given the mentioned importance of private banking. Hens and Bachmann (2008) and Maude (2006) provide general overviews of private banking. Delaloye, Habib, and Ziegler (2012) conduct and event study to investigate the importance of banking secrecy for Swiss private banks. Other streams of literature focus on specific wealth management and banking topics. Foehn (2004) conducts a case study to determine the client value of private

banking clients in Switzerland. Burgstaller and Cocca (2011) study the efficiency of private banking institutions in Switzerland and Liechtenstein. Cocca (2008) considers size effects and integrated business models in private banking in Switzerland and Liechtenstein. Horn and Rudolf (2012) investigate the determinants of service quality and its effects in private banks. Most related to our study, Horn and Rudolf (2011) document that financial security affects customer loyalty more than service quality and they provide a first indication that banks outside Germany benefit more from their reputation for security.

Broadly speaking, our paper is also related to the mutual funds literature, which has investigated determinants of fund flows (Agarwal, Daniel, and Naik (2003), Agarwal, Daniel, and Naik (2009)). While there are some similarities, there are many differences between the sectors, and a transfer of results obtained for mutual funds to private banks is impossible.

This paper is structured as follows. Section 2 presents the theoretical foundation and develops the central hypotheses of this paper. Section 3 introduces the data. Section 4 discusses the results. Section 5 concludes.

2 Hypotheses

2.1 Main Hypotheses

This section derives our central hypotheses. The hypotheses concern the central topics of trust (Hypotheses 1 and 2), service quality and efficiency (Hypotheses 3 and 4), bank-internal incentives and growth of the number of relationship managers (Hypotheses 5 and 6), and performance (Hypothesis 7).

2.1.1 Trust

We begin by observing that a private bank promises to safeguard and to manage deposited assets in an appropriate manner, especially in accordance with the client's desire. Therefore, trust is a critical component in a private bank's ability to attract and retain client funds (Molyneux and Omarini (2005)). We consider two concrete aspects of how clients consider the

trustworthiness and security of a private bank: media coverage (Hypothesis 1) and financial soundness (Hypothesis 2).

Hypothesis 1 (media coverage): Negative media coverage is negatively associated with net new money flows.

The idea behind Hypothesis 1 is that the media play a critical role in influencing the reputation of companies (Jonsson, Greve, and Takako (2009), Meier, Luo, and Oberholzer-Gee (2012), Einwiller, Carroll, and Korn (2010)), and reputation in turn is important to attract and to retain clients. The greater a company's involvement in issues that are intensively and emotionally discussed, the greater is the effect on reputation (Eisenegger, Schranz, and Schneider (2011)).

In the time period this study covers, topics related to the financial sector were in the focus of the media. Some of these topics were in relation to general banking such as the recent financial crisis and regulatory issues. In order to explain the cross-sectional variation in NNM growth, however, we are interested in topics such as banking secrecy, tax related issues or data theft that affected some institutions in particular but not the whole wealth management banking sector equally.

Publicity-shy wealth management clients do not appreciate negative media coverage of private banks for two reasons. First, the desired privacy and discretion are endangered due to increasing media presence of the bank. Second, negative media coverage in relation to tax scandals or data theft lets them question the security of their wealth and casts doubts on the trust they put into the chosen fiduciary relationship with a particular bank.

Hypothesis 2 (financial soundness): Bank leverage is negatively associated with net new money flows.

This hypothesis is motivated by the notion that the ratio of equity to total assets is a source of a bank's inherent trust resources. Doing so, we address the financial security dimension and assume that the amount of trust that private banking clients put in a relationship with a private bank is influenced by the

way the bank finances itself. Arguably, signaling trust is one of the central determinants of a private bank's ability to attract net funds as it signals stability and security as well as a profound understanding of the trustful relationship that affluent clients expect.

An alternative view on the relevance of the capitalization of the private bank is that a high level of leverage is tantamount with an increased aggressiveness of the business model and managerial attitudes.

2.1.2 Service Quality and Efficiency

Private banking is considered as a pure service industry (Chase (1981)). This implies that factors other than product characteristics and price advantages are of vital importance. In particular, the private banking business is predominately determined by service characteristics such as interaction quality (competence, investment proposal), service product quality (performance, product and service range) and service environment quality (financial security and corporate identity).[2] Service, however, is costly, and we need to control for the fact that banks vary in their effectiveness of obtaining NNM with given resources. Therefore, we posit two connected hypotheses:

Hypothesis 3 (service quality): An increase in the service quality offered to existing and potential clients is positively associated with NNM flows.

Hypothesis 4 (efficiency): A higher cost-income-ratio is negatively associated with NNM flows.

Hypothesis 3 reflects the idea that an increase in the scope of offered service increases the intensity of an existing relationship as well as the quality of service. Additionally, it takes into account that traditional products have been expanded to include services such as financial planning and alternative investment advice (Foehn (2004)). We assume that an increase in the offered service level improves the client to relationship-manager ratio. This should

[2] For example, Horn and Rudolf (2012) found that an improvement of service quality leads to a higher growth of assets under management.

support a relationship manager to extend the share of wallet at existing clients and to increase the attractiveness of the bank for potential new clients.

Conversely, Hypothesis 4 captures the notion that the effectiveness in which a private bank conducts its business is reflected in the cost-income-ratio. Managers of a private bank with a high ratio of operating costs to operating income may generally be less effective in generating business; indeed, a high cost-income ratio arguably is related to low managerial ability. Therefore, we expect that a high cost-income-ratio is associated with inefficiency in increasing the asset base and is, therefore negatively, associated with NNM flows.

2.1.3 Employees and Incentives

The next two hypotheses are based on the observation that the relationship manager represents the private bank and is therefore, considered by many practitioners, a very important factor in this special service environment. Indeed, hiring additional relationship managers to increase assets under management is one of the most favored approaches by private banks.

Alternatively, or additionally, relationship managers can be rewarded for their extra effort to attract new assets. Thus, an increase in past bonuses is likely to predict net new money growth this year because relationship managers wish to reach last year's bonus level again. These considerations yield the following two hypotheses:

Hypothesis 5 (employment growth): Additional relationship managers are positively associated with NNM growth.

Hypothesis 6 (incentives): Compensation for relationship managers is positively associated with NNM growth.

2.1.4 Performance

Finally, we note that the goal of private banking clients is to grow or at least maintain their wealth. Horn and Rudolf (2012) show that in a private banking relationship price characteristics such as the price for the service provided is of secondary importance. And a decline in the price-performance ratio may affect

customer satisfaction less than a rise in service quality. However, wealth management clients generally cannot observe the scope of resources that private banks devote to the relationship and during investment process. Furthermore, clients can hardly observe the private bank's ability when recommending an investment. However, clients are aware of past client value created, and thus can use a private bank's past performance to assess credibility and competence (Chemmanur and Fulghieri (1994)). Thus, a natural hypothesis is the idea that clients pay attention to the value created for them as they attempt to make a prediction regarding the bank's competence. Therefore, we posit:

Hypothesis 7 (client value): Better past performance in the sense of greater client value created is positively associated with NNM growth.

Note that a full test of this hypothesis should also consider the risks with which a given performance was achieved. However, this information is not available to us, clearly presenting a limitation of our analysis.

We will also consider some other explanatory variables for which we do not have unambiguous hypotheses.

2.2 Heterogeneous Effects

For all the hypotheses, we also investigate whether larger banks react more to any given factor than smaller banks do. Then, we further explore whether the recent financial crisis has had an effect on the role of some determinants. We do not have unambiguous hypotheses regarding this cross-sectional and time series heterogeneity.

3 Data and Empirical Strategy

3.1 Institutional Setting

We use a hand-collected panel data set of major private banks domiciled in Switzerland. In order to increase sample size and to ensure better robustness of our results, Liechtenstein private banks were also added. We begin with the dataset developed by Birchler et al. (2011) and expand it in several dimensions. Our sample period is 2003 until 2010.

Private banking includes a broad range of financial, advisory, and additional services for domestic and international clients. The core business is the administration of assets and investment advisory, where the customer receive tailor-made solutions (Horn and Rudolf (2011), Cocca (2008)). A private bank was included in the sample if it has a clear strategic focus on private banking and if at least one third of total revenues were generated from fee and commission income. The strategic focus was verified through the overall mission statement in the annual report or on the bank's official internet presence respectively. Furthermore, the availability of an annual report was a necessary condition for inclusion in the sample.

Due to mergers and acquisitions, firm exits, ownership changes, and increased restrictions in data availability some banks dropped out of the sample. The resulting panel data set is unbalanced.

3.2 Dependent Variable

Net new money (NNM) is the net amount of assets under management (*AUM*) of new and existing clients less the amount of assets withdrawn. The Swiss Federal Banking Commission (SFBC)[3] defines AUM to encompass all assets in self-managed collective investment instruments, assets from investors and clients in a wealth management contract. Additionally, AUM include assets in self-managed funds and assets with an investment advisory and/or investment

[3] SFBC Circular 24 (2002), Circular 38 (2006) and Circular 2 (2008).

service mandate.[4] "Custody-Assets" – assets that are held exclusively for safekeeping, custody or transaction purposes – are not considered as AUM as the bank does not provide any consultancy service.[5]

The SFBC requires all Swiss banking institutions to disclose figures on levels and flows of AUM if they have a significant part of their activities in wealth management. Specifically banks are required to disclose their AUM if the net balance of the positions "commission income on securities and investment transactions" and "commission expenses on securities and investment transactions" is greater than one third of the sum of "results from commission and fee business and "trading income" (SFBC, Circular 2/2008. Margins nos. 198f). The NNM-figures have to be disclosed based on the scheme of "Table Q", specified in SFBC Circular 2/2008 (198e) and attached to this paper in the Supplementary Appendix. The disclosure rules do not require separating out inflows and outflows in the presentation of NNM figures.

Importantly, interest and dividend income as well as market and currency movements on clients' assets are excluded from this calculation. Thus, a positive NNM-figure implies that the aggregated net asset inflow is higher than the aggregated amount that clients withdrew in the same period.

In order to capture size effects we standardize NNM figures by the average AUM holdings in the previous and current period to generate *NNM_AUM*, our main dependent variable.

3.3 Main explanatory Variables

MEDIA is a binary indicator variable that equals one if a private bank received a negative media mention in a given year. In order to evaluate media coverage we conduct a content analysis of six of the most popular opinion-forming

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[4] In particular, AUM include liabilities towards customers such as savings and deposits, time deposits, fiduciary deposits and all portfolio assets. However the statement is a non-exhaustive list and further details of inclusion have to be derived from the investment purpose.

[5] As reporting institutions are required to disclose the detailed criteria concerning the classification on custody assets, there could arise potential data limitations.

[6] Depreciations are included into operating costs to account for the fact that banks can either buy or lease tangible assets and, consequently, leasing expense are considered as operational costs and are incorporated in total administrative expenses.

general and business newspapers. We focus on Swiss newspapers and include additionally one main German business newspaper.

For the media analysis we assume that relevant news and bulletins affecting the Swiss financial center and the individual private bank are published and reported in the Swiss home media first and are afterwards translated to international media agencies and broadcasted by international newswires. We conduct a content analysis using LexisNexis Academic International News and Wire database. For each year and institution we search for articles that cover the bank in combination with reportings about tax scandals, banking secrecy, data theft or double taxation agreements. In a second step we classify each article manually to have either positive or negative content. Further details concerning the use of specific search terms and the inspected newspapers and additional information of the media coverage in Switzerland and Germany can be found in the Appendix.

The private bank's capital strength is captured by the *EQUITY RATIO,* which is the proportion of equity to total assets. A high equity ratio signals low balance sheet risk.

SERVICE is defined as the total number of employees standardized by the total amount of assets under management. The *COST-INCOME-RATIO* captures total operating expenses and depreciations per unit of net operating profit.[6] *EMPLOYEES* is the total number of employees. *COMPENSATION* is the total personnel costs a bank shows in its annual report. (Unfortunately, we do not have data on relationship managers specifically.) *EMPLOYEE GROWTH* is the one-year growth rate of *EMPLOYEES*. Our measure of incentives is *COMP-PER-CAPITA*, calculated as *COMPENSATION*, divided by *EMPLOYEES*. This is clearly a highly noisy measure of incentives. It is motivated by (a) the fact that the companies we study are in the same industry and should thus be competitive to each other with respect to pay practices and

[6] Depreciations are included into operating costs to account for the fact that banks can either buy or lease tangible assets and, consequently, leasing expense are considered as operational costs and are incorporated in total administrative expenses.

(b) the notion of basic economic theory that risk-averse agents receiving higher-powered incentives receive higher pay.

CLIENT VALUE is a proxy for the bank's investment performance. It captures the growth of *AUM* over a one-year period, subtracting out the growth of the asset base through net clients' fund flows in the same period.

3.4 Other Control Variables

LOG (ASSETS) is included as a control variable for size effects. *OWN_FUNDS* captures the ratio of assets under management that are managed in bank's own funds.

COMMISSION_INCOME income is defined as the ratio of revenues and income from fees and commissions to the net operating profit. It captures the degree of specialization and is considered to proxy private banking knowledge.

Finally, the ability of a bank to attract funds may be higher if it offers services of special interest to certain client segments.[7] For example, one argument often made by relationship managers and also addressed by Cocca (2008) is that it is important to offer corporate financial advisory services because founders and owners of family firms may be interested in transactions (especially in the context of succession planning). In order to capture the type of the private banks' clients we evaluate each institution's individual internet presence and screen it for advertised clients segments that are served. If an institution is not presented online, we consult the Bloomberg BusinessWeek Company Search[8] and derive client information based on the company description stated.[9] This search results in three variables: *CORPORATE CLIENTS* is a binary indicator equal to one if competencies for corporate advisory services are stated explicitly. This comprises advisory competences and services in areas such as corporate finance, transnational (commodity)

[7] All private banks serve "traditional" private banking customers – individuals that demand strategic asset management, financial planning and portfolio management services.

[8] Available at http://investing.businessweek.com/research/common/symbollookup/symbollookup.asp.

[9] Almost all private banks in our sample are presented in the internet when the search was conducted in April 2012. However some of the institutions dropped out because of mergers and acquisitions. A potential imprecision is inherent in this proceeding as institutions can change or extend its strategic focus.

trade financing, merger and acquisition, share and secondary placements and transaction banking. *INSTITUTIONAL CLIENTS* is a binary indicator equal to one if a private bank offers custodian services for pension funds, insurance companies, family offices, other banks and related brokers. *INDEPENDENT ASSET MANAGERS* is a binary indicator equal to one if a private bank specifically states that it caters to this group of clients.

3.5 Empirical Strategy

We run panel regressions with *NNM_AUM* as our dependent variable and the explanatory variables described above. Our hypotheses concern the cross section of private banks. Therefore, we include time fixed effects in our panel regressions. This also allows us to control for general macroeconomic factors. In particular, in the time period under analysis, the financial sector in general and the Swiss private banking sector specifically were affected by several regional and international challenges. Most importantly, the financial crisis affected primarily the trust and perception of financial institutions. Furthermore, impacts of the financial crisis influenced the potential monetary inflows that could be tied up by Swiss private banks. Changes in the Swiss nominal interest rate and fluctuation of major currencies in relation to the Swiss franc determined the attractiveness of the Swiss financial center for offshore money.

Additionally, we lag all explanatory variables by one year. Lagging each variable is appropriate as we consider annual balance sheet data that usually exhibit a backward oriented view. It also to some extent ameliorates reverse causality concerns.

4 Empirical Analysis

4.1 Descriptive Statistics

Table I provides descriptive statistics. In order to exclude potential misleading results due to outliers (possibly due to the financial crisis or the influence of extremely large or unusual market participants), we winsorize all variables at the 2.5 and 97.5 percent levels.

Table I

Summary Statistics

This table presents summary statistics of the dependent and explanatory variables of Swiss private banks from 2003 to 2010. NNM is the net Swiss franc amount of assets and assets under management of new and existing clients less the amount of assets withdrawn; AUM is the Swiss franc amount of assets and assets under management. NNM_AUM captures the aggregated net amount of assets under management acquired from new and existing clients standardized by the level of previous years AUM, NNM_t divided by the average of AUM_t and AUM_{t-1}. MEDIA is a dummy variable that equals to one if an institution exhibits negative media coverage in the corresponding year. EQUITY RATIO is the ratio of equity to total capital. SERVICE captures the proportion of the number of total employees to total AUM. COST-INCOME-RATIO is the cost-income-ratio. WAGES is the total Swiss franc amount of wages paid to the employees. COMP-PER-CAPITA captures the wage cost per employee and GROWTH-COMP-PER-CAPITA is the growth rate of wages per employee. EMPLOYEE is the total number of employees and EMPLOYEE GROWTH is the annual rate of change. CLIENT VALUE captures the growth of AUM over a one year's period less the growth of the asset base through net clients funds in the same period. CORPORATE CLIENTS, INSTITUTIONAL CLIENTS and INDEPENDENT ASSET MANAGERS are dummy variables that equal to one if the bank serves corporate, institutional or independent asset managers, respectively. OWN_FUNDS captures the ratio of AUM allocated in own funds. COMMISSION INCOME is the proportion of revenues from commissions and fees to total revenues. ASSETS captures the private banks total capital. The data are winsorized at the 2.5th and 97.5th percentiles.

Variable	Mean	Std. Dev.	P25	Median	P75	Min.	Max.	N
NNM (Mio. CHF)	1'439.68	4'140.18	-71.60	122.00	909.11	-2'580.20	19'816.00	521
AUM (Mio. CHF)	23'848.23	41'071.88	1'876.07	6'498.00	25'647.00	437.10	193'350.00	610
NNM_AUM	0.04	0.11	-0.02	0.04	0.09	-0.20	0.32	518
MEDIA (dummy)	0.06	0.24	0.00	0.00	0.00	0.00	1.00	792
EQUITY RATIO	0.16	0.10	0.09	0.14	0.21	0.04	0.51	594
SERVICE	0.02	0.01	0.02	0.02	0.03	0.01	0.07	591
COST-INCOME-RATIO	0.71	0.18	0.58	0.69	0.80	0.38	1.21	647
WAGES (Mio. CHF)	58.12	92.58	5.25	16.70	59.02	1.93	368.20	559
COMP-PER-CAPITA (Mio. CHF)	0.18	0.06	0.14	0.17	0.19	0.08	0.55	548
GROWTH COMP-PER-CAPITA	0.03	0.16	-0.05	0.02	0.10	-0.41	1.18	461
EMPLOYEE (number)	381.63	602.23	38.50	120.00	412.00	12.00	2'573.00	639
EMPLOYEE GROWTH	0.05	0.14	-0.02	0.03	0.10	-0.21	0.43	540
CLIENT VALUE	0.00	0.16	-0.07	0.02	0.09	-0.33	0.39	474
CORPORATE CLIENTS (dummy)	0.23	0.42	0.00	0.00	0.00	0.00	1.00	890
INSTITUTIONAL CLIENTS (dummy)	0.45	0.50	0.00	0.00	1.00	0.00	1.00	890
INDEPENDENT ASSET MANAGERS (dummy)	0.51	0.50	0.00	1.00	1.00	0.00	1.00	890
OWN FUNDS	0.05	0.09	0.00	0.00	0.08	0.00	0.32	585
COMMISSION INCOME	0.63	0.13	0.54	0.63	0.73	0.38	0.89	606
ASSETS (Mio. CHF)	4'154.85	7'796.12	298.50	898.15	2'858.70	54.34	33'772.90	538
LOG ASSETS	6.92	1.72	5.70	6.80	7.96	4.01	10.43	538

As already mentioned in the previous section, the Swiss private banking market exhibits a high degree of heterogeneity. Thus, an average private bank in our sample exhibits about CHF 23 billion of assets under management and attracts on average CHF 1.4 billion of net funds each year. However, the median bank exhibits assets under management of around CHF 6.5 billion and attracts CHF 122 million. This high skewness is due to the fact that both big

banks, UBS Wealth Management and Credit Suisse Private Banking, manage more than the half of total AUM in our sample and the combined market share of the group of smallest 40 banks represent only 3 percent of our total sample.

There also occurs substantial variation in assets and assets under management. Furthermore, these absolute assets measures are heavily skewed and the mean-to-median ratio ranges between 3.6 for assets to around 12 for net new money. Therefore, we conduct the subsequent analysis based on ratios. New funds correspond to around 4 per cent of the total assets base on average.

As for the other variables, the average amount of total assets per bank is CHF 4.1 billion and consists of around 16 percent equity. The average private bank in our sample employs 400 employees and exhibits annual wage costs of about CHF 58 million CHF. On average, an employee earns about CHF 180’000 and the annual growth of the number of total employees is by around 2 percentage points higher than the average increase of compensation per capita. Some of these variables, too, are highly skewed.

There is not only significant cross-sectional variation in net new money, but also considerable time series variation. Figure 1 plots average the average NNM development over time.

4.2 Main Hypotheses

Table II presents our main results. It also shows the expected signs for the hypotheses.

Consistent with Hypothesis 1, we find that negative media coverage in the previous year is robustly negatively associated with NNM-flows. Private banks experiencing negative media coverage display decelerated net asset growth by around 3 percent in the subsequent year.

private bank that exhibits an average level of equity ratio (0.16) increases its equity ratio to the upper quartile of our sample (0.21), then the resulting average growth of the asset base decreases by about 0.66 (=0.132*0.05) percent. These results reject Hypothesis 2. A possible explanation is that besides the effect of the equity ratio as a signal of quality a second effect

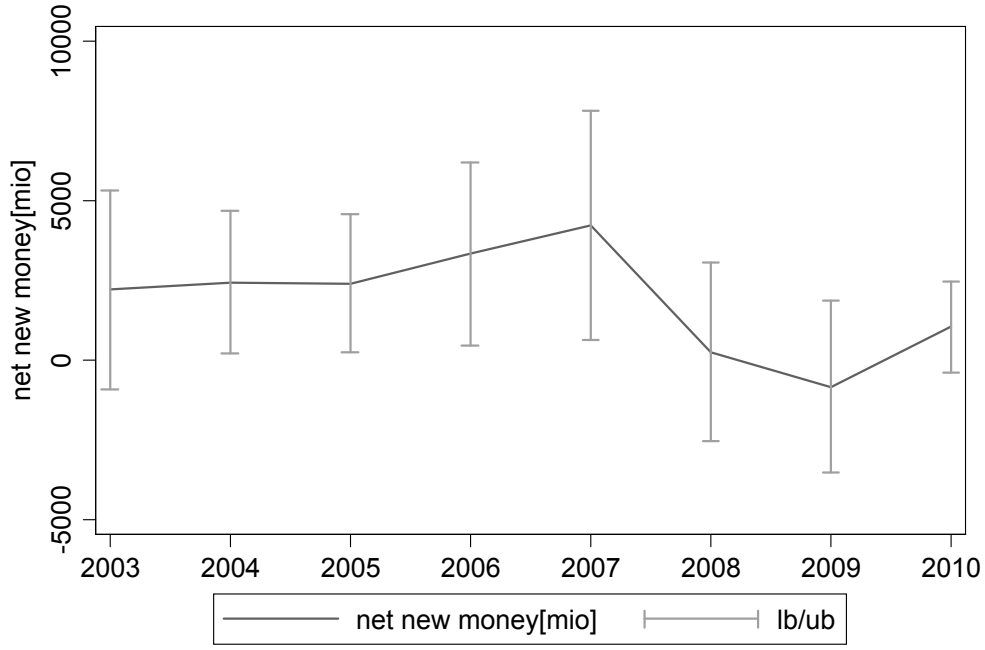

Figure 1. Development of Net New Money. This figure depicts CHF levels of NNM over the sample period. The levels are reported in Mio. CHF and *lb* and *ub* capture the lower and upper bound of the sample distribution, respectively.

comes in. Recent research documents that leverage decisions are to a significant extent driven by managerial preferences (Lemmon, Roberts, and Zender (2008)). Thus, high leverage (a low equity ratio) may be reflecting confident, aggressive, perhaps even risk-loving management. These managers would at the same time also be very entrepreneurial and innovative in their attempts to acquire additional assets under management, which would yield the correlation we observe in the data. We cannot definitively ascertain the channel through the finding arises; what would be needed to address this issue further is an exogenous shock to leverage that is unrelated to managerial characteristics.

Next, we find significant evidence in favor of Hypothesis 3. As seen in Column (3) and other regressions, an increase in the client-to-relationship manager ratio (SERVICE) predicts an increase in NNM flows. For an average private bank of our sample an increase in its service ratio by 10 per cent is associated with growth in AUM of around 3.5 percent. However, the potential to increase NNM only through an increase in service is dampened by the fact that private banks that operate less efficiently in general (have a high cost-

income ratio) also are less effective in obtaining NNM, which confirms Hypothesis 4.[10]

Next, Column (4) suggests that incentive effects do exist: An increase in wages, which, as argued earlier, is a reasonable proxy for the power of incentives in the private bank, is associated with positive AUM-growth. When an average private banking institution increases its average compensation per employee by 20 percent, this translates to an increase of AUM by almost 4 percent. In contrast, external growth (an increase of headcount, for example, through the acquisition of a team of relationship managers from a competitor) is not a significant determinant of NNM on average. (As we will see below, however, this insignificant result is the result of substantial heterogeneity between banks in this respect.)

Column (5) shows that past performance does not explain future NNM-growth; thus, Hypothesis 7 is not confirmed on average.

Finally, Column (6) includes all variables considered so far and introduces a set of control variables that are likely to pick up significant bank fixed effects. Notably, all the previous results by and large hold also in this "kitchen-sink" regression. There are few other strong effects. Interestingly, the potential to offer own funds products/ to allocate funds in the own institution tends to allow the private bank to increase NNM-growth; the effect is not significant on conventional levels, however. Moreover, it turns out that NNM-growth is not determined by the client base/ portfolio of clients that are served. In particular, there seem to exist no cross-selling effects between private banking and investment/corporate banking for attracting net funds. If anything, private banks also offering corporate services are less successful in attracting client funds, controlling for the other variables.

[10] An alternative explanation for the negative coefficient on the cost-income-ratio runs as follows. Suppose that an increase in the share of wallet of existing customers has a more positive effect in generating income than the acquisition of new clients. This may be plausible if new clients imply higher acquisition costs and assigned capacities (such as increases in relationship management or performance reporting requirements) than old existing clients. Then, if a bank was successful in targeting new clients last year, it may have exhausted its potential to reach new clients then, implying lower NNM this year. This would yield the correlation observed in the data.

4.3 Heterogeneous Effects across Banks

Table III investigates whether the effects vary across institutions. In particular, we are interested in whether large private banks behave differently than small private banks. To study this possibility, we interact variables of interest with our proxy for bank size, LOG ASSETS.

In Column (1) we observe that negative effects of negative media coverage are less serious for larger private banks. Indeed, for the largest private banks in our sample, starting at the upper quartile, the negative effect of negative media coverage becomes negligibly small. This compensating effect of size may be based - at least partially - on the sobriety and soundness that larger private banks convey.

Alternatively, larger wealth management institutions are faced with a constant media observance, which makes single negative media articles be of minor importance, and allows the banks to more effectively and actively response to negative news. Furthermore, larger size private banks employ well-staffed public relation offices that enables them to deal and respond in a more sophisticated manner with negative media coverage.

The opposite tends to be the case for the equity ratio, as can be seen in Column (2). As previously seen, higher leverage enables private banking institutions to increase their asset base. This analysis reveals this effect mainly arises for larger institutions. Consider again a quantitative example.

Assume that leverage increases by 5 per cent. This corresponds to a decrease in the equity ratio from 0.16 to 0.11. Then, NNM-growth of a representative bank of the lower quartile of our sample increases by around 2 per cent. That effect is even more pronounced, the larger the private bank is.

Thus, for a private bank of the upper quartile the reduction in leverage, increases NNM-growth by around 2.5 percent.

Column (3) shows that the scope of service offered to clients is more important for small-sized private banks than for larger banks, and the incentive effect is more pronounced for large private banks.

Table II

Main Results

This table examines panel regressions of yearly net new money of Swiss private banking institutions on bank characteristics from 2003 to 2010. The dependent variable is *NNM_AUM* and captures the aggregated net amount of assets under management acquired from new and existing clients standardized by the average of AUM_t and AUM_{t-1}. *MEDIA* is a dummy variable that equals to one if an institution exhibits negative media coverage in the corresponding year. *EQUITY RATIO* is the ratio of equity to total capital. *SERVICE* captures the proportion of the number of total employees to total AUM. *COST-INCOME-RATIO* is the Cost-Income-Ratio. *COMP-PER-CAPITA* captures the wage cost per employee and *EMPLOYEE GROWTH* is the annual rate of change of the number of total employees. *CLIENT VALUE* captures the growth of AUM over a one year's period less the growth of the asset base through net clients funds in the same period. *CORPORATE CLIENTS*, *INSTITUTIONAL CLIENTS* and *INDEPENDENT ASSET MANAGERS* are dummy variables that equal to one if the bank serves corporate, institutional or independent asset managers, respectively. *OWN FUNDS* captures the ratio of AUM allocated in own funds. *COMMISSION INCOME* is the proportion of revenues from commissions and fees to total revenues. *ASSETS* captures the private banks total capital. All explanatory variables are lagged by one year. The numbers in parentheses are standard errors, clustered at the bank level. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Hyp.	(1)	(2)	(3)	(4)	(5)	(6)
MEDIA	(-)	-0.036*			-0.045*		-0.053**
		(-1.80)			(-1.80)		(-2.11)
EQUITY RATIO	(+)		-0.132*		-0.166*		-0.166*
			(-1.71)		(-1.65)		(-1.71)
SERVICE	(+)			1.632**	2.271**		2.531**
				(2.15)	(2.33)		(2.46)
COST-INCOME-RATIO	(-)			-0.083**	-0.122***		-0.118***
				(-2.32)	(-3.75)		(-3.11)
COMP-PER-CAPITA	(+)				0.193*		0.172
					(1.73)		(1.50)
EMPLOYEE GROWTH	(+)				0.001		-0.027
					(0.01)		(-0.53)
CLIENT_VALUE	(+)					0.023	0.038
						(0.63)	(0.85)
CORPORATE CLIENTS							-0.019
							(-1.21)
INSTITUTIONAL CLIENTS							0.006
							(0.36)
INDEPENDENT ASSET MANAGERS							0.011
							(0.54)
OWN FUNDS							0.087
							(1.36)
COMMISSION INCOME							-0.006
							(-0.09)
LOG ASSETS		-0.001	-0.007	-0.002	-0.005	0.000	-0.003
		(-0.18)	(-1.41)	(-0.40)	(-0.88)	(0.06)	(-0.45)
Constant		0.013	0.076	0.043	0.079	-0.001	0.049
		(0.38)	(1.60)	(0.93)	(1.30)	(-0.03)	(0.64)
N		409	408	402	335	333	320
Number of Banks		79	79	79	78	78	78
Year FE		Yes	Yes	Yes	Yes	Yes	Yes
R^2		0.093	0.094	0.094	0.13	0.066	0.13

Interestingly, while employee growth is insignificant in the main regressions, the interaction term with size in Column (3) of Table III reveals a potential positive size effect. Thus, as bank size increases, this interaction term increases its dominance on the association between employees and NNM-growth. Thus, very large institutions can increase their asset growth by raising the number of employees, that is growing inorganically. This interaction can be due to increasing financial capacities as well as organizational capabilities that larger institutions exhibit, in contrast to institutions of average size or smaller private banks, respectively.

Further results reveal potential size effects of the interaction with the clients segment that is served. It seems to be potentially lucrative only for larger private banks to serve corporate clients. Specifically, solely private banks with a minimal asset size of CHF 2.8 billon are able to compensate the initial negative effect that occurs when serving corporate clients.

Remarkably, clients' reaction on negative media coverage does not seem to be associated with their professional background (see Column 4). Solely independent asset managers do exhibit a less negative reaction to negative media coverage shocks than other clients segments do.

4.4 Heterogeneous Effects across Time

The main focus of this paper is on understanding the cross-sectional variation of NNM-growth. As a final step in the analysis, however, we now briefly consider variation in the role of determinants of NNM over time. Our interest in this analysis lies with the potential repercussions of the global financial turmoil of 2007/2008. The financial crisis had a distinctive influence on the financial sector in general and on the private banking sector in particular. Due to losses from the crisis, the asset base was reduced massively and in addition, the perception as well as the reputation of the financial sector suffered massively. To evaluate how this additional external pressure affected the role of the determinants of NNM flows, we interact variables of interest from the previous observations with a time dummy variable for the time after the

financial crisis, *AFTERCRISIS*, namely the years 2008 until 2010. (Naturally, we now omit year dummies from the regressions.)

The results are presented in Table IV. First, as expected, there is a significant reduction in NNM-growth in the time after the financial crisis. Interestingly, there are few significant changes in the role of determinants of NNM, but some patterns are noteworthy. For example, we cannot observe any shift toward a more sensitive response on negative news about private banks evoked through the financial turmoil (Column (1)). Perhaps there were that many negative reports about the financial sector that single news that were in our focus did not carry special weight.

Column (2) reveals that the negative effects of the equity ratio on NNM-growth do not seem to be impaired by the financial crisis; Column (3) does not show any influence of the crisis for the effects of changes in the service level and its interaction with the cost-income-ratio; and in Column (4) we observe that there occurred no significant shift in the role of the client structure in the time period after the turmoil.

Strikingly, however, aft client value turns out to be a highly significant factor in determining NNM-growth *before* and up to the crisis. Thus, signaling higher past performance historically did allow private banks to increase their NNM-growth. It will be interesting to see whether this occurs again in the future when markets calm down.

Finally, Column (6) shows that the ability to offer own managed funds becomes an important factor after the financial crisis. For an average private bank this implies that after the financial crisis the ability to offer own managed funds products increases NNM-growth by around 1.5 percentage points.

5 Conclusions

This is one of the first papers to systematically investigate the determinants of net money flows into and from private banks. Using a comprehensive sample of Swiss private banks, we have obtained several novel insights into the drivers of assets under management. First, we document a strong negative

Table III

Heterogeneous Effects Across Banks

Each column in this table reports a panel regression of yearly net new money of Swiss private banking institutions on bank characteristics from 2003 to 2010. The dependent variable is *NNM_AUM* and captures the aggregated net amount of assets under management acquired from new and existing clients standardized by the average of AUM_t and AUM_{t-1}. *MEDIA* is a dummy variable that equals one if an institution exhibits negative media coverage in the corresponding year. *EQUITY RATIO* is the ratio of equity to total capital. *SERVICE* captures the proportion of the number of total employees to total AUM. *COST-INCOME-RATIO* is the Cost-Income-Ratio. *COMP-PER-CAPITA* captures the wage cost per employee and *EMPLOYEE GROWTH* is the annual rate of change of the number of total employees. *CORPORATE CLIENTS*, *INSTITUTIONAL CLIENTS* and *INDEPENDENT ASSET MANAGERS* are dummy variables that equal to one if the bank serves corporate, institutional or independent asset managers, respectively. *ASSETS* captures the private banks total capital. All explanatory variables are lagged by one year. The numbers in parentheses are standard errors, clustered at the bank level. ∗, ∗∗, and ∗∗∗ indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
MEDIA	-0.222**	-0.210*	-0.275**	-0.283**	-0.293***	-0.277**	-0.221*	-0.313***
	(-2.15)	(-1.89)	(-2.09)	(-2.15)	(-2.70)	(-2.08)	(-1.74)	(-2.58)
MEDIA X LOG ASSETS	0.023*	0.022*	0.029*	0.029*	0.019	0.028*	0.023	0.021
	(1.93)	(1.71)	(1.91)	(1.94)	(1.35)	(1.86)	(1.53)	(1.35)
EQUITY RATIO		0.178	-0.012	-0.232	0.045	-0.096	0.185	-0.266
		(0.79)	(-0.04)	(-0.72)	(0.16)	(-0.36)	(0.80)	(-1.07)
EQUITY RATIO X LOG ASSETS		-0.062	-0.040	-0.007	-0.053	-0.029	-0.065*	-0.032
		(-1.61)	(-0.96)	(-0.14)	(-1.22)	(-0.66)	(-1.76)	(-0.77)
SERVICE			7.952**	9.659***	8.773**	9.057**	3.386	10.366***
			(2.18)	(2.77)	(2.38)	(2.51)	(1.11)	(2.69)
SERVICE X LOG ASSETS			-0.889	-1.093**	-0.982*	-1.034*	-0.416	-1.300**
			(-1.59)	(-1.97)	(-1.71)	(-1.81)	(-0.79)	(-1.97)
COST-INCOME-RATIO			-0.068	-0.055	-0.083	-0.085	0.117	-0.066
			(-0.72)	(-0.59)	(-0.88)	(-0.89)	(1.00)	(-0.67)
COST-INCOME-RATIO X LOG ASSETS			-0.008	-0.015	-0.008	-0.008	-0.033*	-0.013
			(-0.56)	(-1.00)	(-0.56)	(-0.52)	(-1.93)	(-0.81)
COMP-PER-CAPITA			1.522**	1.673**	1.666**	1.523**		1.778**
			(2.09)	(2.49)	(2.26)	(2.16)		(2.54)
COMP-PER-CAPITA X LOG ASSETS			-0.189*	-0.213**	-0.211**	-0.192*		-0.220**
			(-1.84)	(-2.22)	(-2.00)	(-1.89)		(-2.22)
EMPLOYEE GROWTH			-0.344**	-0.355**	-0.344**	-0.332**		-0.384***
			(-2.33)	(-2.39)	(-2.25)	(-2.22)		(-2.60)
EMPLOYEE GROWTH X LOG ASSETS			0.048***	0.049***	0.047**	0.045**		0.050***
			(2.61)	(2.72)	(2.47)	(2.49)		(2.86)
INSTITUTIONAL CLIENTS				-0.008	0.011	-0.010	-0.018	-0.228*
				(-0.09)	(0.60)	(-0.34)	(-0.56)	(-1.79)
CORPORATE CLIENTS				-0.239***	-0.003	0.025	0.008	-0.387***
				(-2.93)	(-0.14)	(0.68)	(0.17)	(-2.63)
INDEPENDENT ASSET MANAGERS				-0.014	0.011	0.018	-0.026	0.008
				(-0.15)	(0.62)	(0.65)	(-0.77)	(0.07)
INSTITUTIONAL CLIENTS X LOG ASSETS				0.003				0.020
				(0.27)				(1.35)
CORPORATE CLIENTS X LOG ASSETS				0.030***				0.043***
				(2.75)				(3.12)
INDEPENDENT ASSET MANAGERS X LOG ASSETS				0.003				-0.003
				(0.26)				(-0.22)
INSTITUTIONAL CLIENTS X MEDIA					0.038			0.043
					(0.66)			(0.66)
CORPORATE CLIENTS X MEDIA					-0.007			-0.016
					(-0.15)			(-0.33)
INDEPENDENT ASSET MANAGERS X MEDIA					0.088*			0.095*
					(1.94)			(1.79)
INSTITUTIONAL CLIENTS X EQUITY RATIO						0.134		0.356
						(0.87)		(1.48)
CORPORATE CLIENTS X ERATIO						-0.226		0.117
						(-1.09)		(0.48)
INDEPENDENT ASSET MANAGERS X ERATIO						-0.014		0.010
						(-0.07)		(0.04)
INSTITUTIONAL CLIENTS X SERVICE							1.051	1.731
							(0.56)	(0.88)
CORPORATE CLIENTS X SERVICE							-0.419	1.333
							(-0.21)	(0.75)
INDEPENDENT ASSET MANAGERS X SERVICE							1.860	0.469
							(0.95)	(0.23)
LOG ASSETS	-0.002	-0.001	0.052**	0.053**	0.059**	0.054**	0.031**	0.054**
	(-0.49)	(-0.14)	(2.03)	(2.02)	(2.16)	(2.00)	(2.06)	(2.00)
Constant	0.019	0.042	-0.304*	-0.291	-0.343*	-0.311*	-0.108	-0.259
	(0.56)	(0.84)	(-1.68)	(-1.62)	(-1.82)	(-1.68)	(-1.04)	(-1.45)
N	409	408	335	335	335	335	400	335
Number of Banks	79	79	78	78	78	78	79	78
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.10	0.12	0.17	0.20	0.19	0.18	0.16	0.23

influence of negative media coverage on private bank's ability to increase the asset base. Additionally, and surprisingly, trying to signal security by less leverage and acting less aggressive when attracting new funds does not seem to pay off; indeed, higher leverage is associated with an increase in the growth of assets under management.

We argued that this finding may pick up heterogeneity in managerial preferences that also translate into policies for how NNM is acquired. Inorganic growth, that is, solely increasing the number of relationship managers generally does not play a role for NNM, while efficiency is important. We also provide evidence for size effects in Swiss private banking.

For example, larger institutions are less affected by negative media coverage and can benefit more from external growth. Up to the financial crisis, client value created was an important determinant of NNM; the crisis appears to have shifted the focus away from performance, at least temporarily.

Our analysis, while the most comprehensive of its kind, still presents some limitations. While an advantage of this study is that we used data that are in principle publicly available, even more progress could be made with more specific, often highly confidential data. For example, we were only able to investigate net new money; ideally, researchers would have access to inflows and outflows separately. Also, we do not have data on the source of funds.

Clearly, it would be exciting to study fund flows from one bank to another. Similarly, the domicile of the investor would be extremely useful information to have, especially in conjunction with events that occurred in some countries. In other words, our study provides a first informative look on the macroeconomic landscape of value drivers of private banks, and it suggests that a microeconomic investigation, drawing on more detailed data would be a promising topic for future research.

Table IV

Heterogeneous Effects Across Time

This table examines panel regressions of yearly net new money of Swiss private banking institutions on bank characteristics from 2003 to 2010. The dependent variable is *NNM_AUM* and captures the aggregated net amount of assets under management acquired from new and existing clients standardized by the average of AUM_t and AUM_{t-1}. *AFTERCRISIS* is a dummy variable that equals one for the years 2009 and 2010. *MEDIA* is a dummy variable that equals one if an institution exhibits negative media coverage in the corresponding year. *EQUITY RATIO* is the ratio of equity to total capital. *SERVICE* captures the proportion of the number of total employees to total AUM. *COST-INCOME-RATIO* is the Cost-Income-Ratio including depreciations. *COMP-PER-CAPITA* captures the wage cost per employee and *EMPLOYEE GROWTH* is the annual rate of change of the number of total employees. *CORPORATE CLIENTS*, *INSTITUTIONAL CLIENTS* and *INDEPENDENT ASSET MANAGERS* are dummy variables that equal to one if the bank serves corporate, institutional or independent asset managers, respectively. *CLIENT VALUE* captures the growth of AUM over a one year's period less the growth of the asset base through net clients funds in the same period. *OWN FUNDS* captures the ratio of AUM allocated in own funds. *COMMISSION INCOME* is the proportion of revenues from commissions and fees to total revenues. *ASSETS* captures the private banks total capital. All explanatory variables are lagged by one year. The numbers in parentheses are robust standard errors, clustered at the bank level. ∗, ∗∗, and ∗∗∗ indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
AFTERCRISIS	-0.034***	-0.055**	0.032	-0.039**	0.041	-0.002
	(-2.88)	(-2.44)	(0.57)	(-2.24)	(0.76)	(-0.04)
MEDIA		-0.049**	-0.042*	-0.046**	-0.030	-0.032
		(-2.28)	(-1.92)	(-2.10)	(-1.24)	(-1.35)
MEDIA X AFTERCRISIS		0.047				
		(1.08)				
EQUITY RATIO		-0.151*	-0.139	-0.145	-0.168*	-0.168**
		(-1.87)	(-1.63)	(-1.57)	(-1.80)	(-2.02)
EQUITY RATIO X AFTERCRISIS		0.106				
		(0.84)				
SERVICE			1.534*	1.522**	1.897*	
			(1.81)	(1.98)	(1.82)	
SERVICE X AFTERCRISIS			-1.426		-1.761	
			(-1.08)		(-1.20)	
COST-INCOME-RATIO			-0.085**	-0.111***	-0.076**	
			(-2.00)	(-2.99)	(-1.97)	
COST-INCOME-RATIO X AFTERCRISIS			-0.031		-0.030	
			(-0.37)		(-0.38)	
CORPORATE CLIENTS				-0.012		
				(-0.69)		
CORPORATE CLIENTS X AFTERCRISIS				0.011		
				(0.34)		
INSTITUTIONAL CLIENTS				0.011		
				(0.65)		
INSTITUTIONAL CLIENTS X AFTERCRISIS				-0.003		
				(-0.13)		
INDEPENDENT ASSET MANAGERS				0.013		
				(0.69)		
INDEPENDENT ASSET MANAGERS X AFTERCRISIS				0.031		
				(1.33)		
CLIENT VALUE					0.134***	0.065
					(2.59)	(1.64)
CLIENT VALUE X AFTERCRISIS					-0.140	
					(-1.38)	
OWN FUNDS						-0.017
						(-0.19)
OWN FUNDS X AFTERCRISIS						0.300*
						(1.79)
COMMISSION INCOME						-0.045
						(-0.60)
COMMISSION INCOME X AFTERCRISIS						-0.039
						(-0.51)
LOG ASSETS	-0.003	-0.008	-0.008	-0.009	-0.005	-0.007
	(-0.71)	(-1.45)	(-1.49)	(-1.57)	(-0.88)	(-1.09)
Constant	0.059*	0.121**	0.144***	0.164***	0.108*	0.127
	(1.91)	(2.55)	(2.67)	(2.79)	(1.88)	(1.58)
N	409	408	401	401	329	332
Number of Banks	79	79	79	79	78	78
R^2	0.015	0.033	0.047	0.057	0.073	0.078

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Appendix

Media Analysis

For each institution in the database we conduct a media search in LexisNews Academic International News and Wire database. Articles are collected from five national Swiss newspapers and one German business newspaper. Each institution's name is connected with the following search terms. In order to account for different spellings or plural/singular occurrences of distinct word, we use the following search operators. "!" picks up any number of letters after a root word; "*" serves as a placeholder for one letter; "w/n" is a proximity connector which is used to establish a relationship between terms; the letter "n" can present an arbitrary number.

Search terms	
Amnestie w/10 steuer	Kunden!
nicht w/2 deklariert*	Repatr!
Amtshilf!	Schwarzgeld
angeklag!	Scudo!
anklage	Steuerab!
Bankd!	Steuerbe!
Bankgeheim!	Steuerdaten
Doppelbest!	Steuerfl!
Finanza!	Steuerhinter!
Finanzp!	Steuersünd!
Geldw!	Steuerver!
Gesetz!	Strafsteuer
IRS!	unversteuert*
Kont**dat!	

Title	Type of medium	Circulations[11]
Tages-Anzeiger	Daily newspaper	195‘618
Neue Zürcher Zeitung (NZZ)	Daily newspaper	132‘670
NZZ am Sonntag	Weekly newspaper	130‘133
Financial Times (Deutschland)	Daily newspaper	100’393
Handelszeitung	Weekly newspaper	36’230
Finanz und Wirtschaft	Biweekly newspaper	29‘517

Table Q

Table Q based on Margins nos. 198a and 198b of guidelines of Swiss Federal Banking Commission on financial statement reporting

Assets under management

Type of assets under management	Reporting year	Previous year
Assets in own-managed collective investment schemes		
Assets with management mandate		
Other assets under management		
Total assets under management (including double counting)		
Of which double counting[12]		
Change through net new money (including double countings)		

[11] Information based on published media information downloaded from the newspaper’s website; data were recorded on June 2012.

[12] Double countings incorporates assets in self-managed funds, funds in customers‘ accounts that were already classified as assets under management.

Executive Compensation and Disclosure of Compensation in Switzerland[†]

Michael R. Reichenecker and Alexander F. Wagner[‡]

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Employing a comprehensive dataset of executive and board compensation and management and board shareholding information of 100 Swiss listed companies for the time period 2007-2011, we document significant evidence of a pay-for-performance relationship in CEO pay. We show that the CEO pay-performance relationship is somewhat weaker in Small-Cap companies than in large firms. However, Swiss CEO's are not solely rewarded for individual performance; rather, part of their compensation is related to general sector or exchange rate changes, indicating potential deficits in pay design. We also describe trends in disclosure of compensation matters.

JEL-classification: G34.

Keywords: CEO compensation; pay-for-performance.

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1. Introduction

This is one of the first papers providing a comprehensive overview of the contemporaneous structure and levels of board and executive compensation in Switzerland. The study is timely and important – executive compensation is one of the most hotly and most publicly discussed topics in economics and finance, especially in highly developed economies like Switzerland. Managerial pay is also a focal point of regulatory actions, including requirements regarding disclosures.[1] Surprisingly, very little academic work is available on executive compensation in Switzerland.[2] Evaluating a hand-collected sample of compensation data of around 100 of the largest Swiss companies for the time period 2007-2011, this paper seeks to fill this gap. We provide four key findings.

First, we begin by providing descriptive evidence of the level and development of executive compensation. Notably, CEO pay in the largest companies decreases substantially over the time period (with the largest decrease after the 2007 crisis), while executive pay in the other companies remained largely stable. We document large differences in the composition of pay; top executives of large companies receive significantly more equity-based compensation than their counterparts in small companies. Other, less visible pay components (such as pension payments) appear to have become more important in recent years, relative to cash bonus payments.

Second, we analyze the extent to which Swiss CEOs are rewarded for performance. To our knowledge, this is the first systematic evaluation of this kind in an academic study. We find a surprisingly strong and consistent pay-performance relationship: higher return on assets, higher return on equity, and higher (lagged) total shareholder return are all significantly positively related to CEO pay. Accounting variables such as EBITDA or earnings per share

[1] For example, the "Initiative gegen die Abzockerei" demands that shareholders obtain the right of binding say-on-pay. (See Wagner and Wenk (2012) for an analysis of the market reaction to the initiative.) The Transparency Act of 2007 requires firms to disclose detailed compensation data, and the SIX Exchange Regulation has stipulated detailed additional disclosure requirements.

[2] Some work exists that looks at international comparisons of executive pay, including Switzerland (Aggarwal, Erel, Ferreira, and Matos (2011)). However, these studies do not provide detailed accounts of compensation in Switzerland.

offer lower explanatory power for the variation in CEO pay. Interestingly, the quality of corporate governance is not associated with compensation. We also assess the quality of the pay setting process and question whether there exist incentive schemes that reward the CEO for firm performance that are beyond the CEO's control. Indeed, we find that firm performance driven purely by "luck" – such as positive sector performance or favorable developments in terms of the exchange rate with countries to whom a firm exports a large fraction of its sales – is a highly significant determinant of total pay and in particular of the equity-based portion of pay. Seen from an agency theoretic perspective – under which observable external components of firm performance should be filtered out when assessing a CEO's performance – this suggests potential deficiencies in the pay process for Swiss executives.

Third, we provide an overview about the structure and the changes of wealth levels of Swiss executives. The median CEO of the 100 largest Swiss corporations holds about 0.04% of the market value of his company, around CHF 1 million, that is, approximately three times his yearly salary. By comparison, the median CEO of the 1,500 largest US corporations holds about 0.72% of the market value of his company, around USD 7.5 million, that is, approximately eleven times his yearly salary. There is, however, large variation across firms.

Finally, we turn to the regulatory perspective and assess the quality of compliance of compensation disclosures with regulatory requirements. Not surprisingly, but reassuringly, we document a trend of improved disclosure in the past three years.

This paper is structured as follows: Section 2 describes the sample and the data used. Section 3 provides a detailed overview about executive and board compensation. Section 4 analyses patterns of pay-performance relationships. Section 5 presents an analysis of executive wealth and ownership incentives. Finally, Section 6 provides an analysis of compensation disclosure practices in Switzerland, and section 7 concludes.

2. Data

2.1. Sample

Our sample consists of the 100 largest companies listed at the Swiss stock exchange. We distinguish between three groups of firms. The first group includes the 20 companies of the major blue-chip Swiss Market Index (SMI). The second group includes all companies of the SMIM index, capturing the next 30 largest and most liquid *Mid-Cap* stocks. These 50 companies add up to around 90 percent of the capitalization of the Swiss equity market. In order to get an even more representative sample, we extend our analysis to the following 50 companies according to their market capitalization in the year 2007. In the following, we refer to this third group as *Small-Cap* companies. The full market capitalization of our total sample as of 31.12.2011 is CHF 881 billion.

2.2. CEO Pay and Wealth Variables

We study hand-collected panel data of board and executive committee compensation and management's shareholding data. (For the largest 48 companies compensation data comes from PricewaterhouseCoopers (2008, 2009, 2010, 2011, 2012).)

We collect data on total annual payments (*TOTAL PAY*) as well as decomposed into fix and variable components. The components of annual payments are annual guaranteed fixed cash payments (*BASE CASH PAY*), a discretionary variable cash bonus (*VARIABLE CASH*) and equity-based payments associated with long-term incentive plans (*LTIP*). For the purpose of this study we summarize all reward components paid in equity as LTIP.[3] All other remaining payment components, such as director fees and emoluments for management service or pension contributions are captured as "other payments" (*OTHER PAY*).

Furthermore, we gather data on the accumulated number of stocks held by all board and executive committee members. In order to derive the value of

[3] Some of the payments are part of the base compensation, while others are a form of bonus payment.

these equity holdings (*VALUE SHAREHOLDINGS*) we value each holding position with the stock price of the firm at the end of the corresponding year.[4]

2.3. Firm Characteristics and Performance Measures

We consider the size of the firm as one of the most important determinants of executive pay. Firm size is captured by total assets (*TOTAL ASSETS*) and defined as the sum of total current assets, long term receivables and investments.[5] The scope of a firm's foreign exposure is denoted by the stake of international sales to total sales (*FOREIGN SALES*).

We control for the risk exposure of the firm. Garen (1994) showed that firms with higher levels of risk are more likely to offer executives higher compensation levels. We employ a static beta factor (*BETA*) to capture the elasticity of movements in the stock price to movements in the market as a whole. BETA is estimated based on a 2½ year stock price history and the Swiss Performance Index as the corresponding underlying market.

Next, our primary firm performance measures are return on equity (*ROE*) and return on assets (*ROA*). *ROE* denotes the ratio of operating income (*EBITDA*) to the shareholder's equity, and *ROA* captures the ratio of *EBITDA* to the book value of assets. *EBITDA* is the earnings before interest, taxes, and depreciation.

As an additional measure of firm performance – capturing directly the value generated for shareholders – we also incorporate the total shareholder return (*TOTAL RETURN*). Further measures of firm performance are earnings per share, growth of sales and the growth of accounting returns.

All data on firm characteristics are from Thomson Reuters Datastream.

2.4. Governance Measures

We include two direct controls for governance: the total number of directors (*NO OF DIRECTORS*) and the equity stake held by the CEO

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[4] Data on option holdings are in principle also available. However, disclosure is too limited to allow a reliable valuation of these options.

[5] Market capitalization could also be a suitable measure to capture size. However the market value of a firm may be correlated with the total return, one of our measures of firm performance.

(*EQUITY OWNED*). Both controls aim to capture potential power effect that enable the CEO to enforce influence on the board. Larger boards tend to be associated with worse governance, though the literature is somewhat ambiguous on this subject (Adams, Hermalin, and Weisbach (2010)). Higher managerial shareholdings can indicate better governance, though there is the danger of excessive insider influence.

Additionally we control for the firm's compliance with regulatory disclosure requirements captured by the disclosure score (*DISCLOSURE SCORE)*; this score is described in Section 6.

2.5. Macroeconomic Variables

The *EXPORT PRICE INDEX* measures the price level of a fixed set of Swiss produced goods for the external market. The statistic is based on the terms of trade collected by the Swiss federal statistical office and establishes the relationship, for a given product, between the price index of exports and imports. We use this information to construct the measure of external "lucky" developments for a firm.

3. The Executive and Board Pay Landscape

3.1. Level of CEO Pay

Table I Panel A provides a summary statistics of the most important pay variables in real terms. It reveals that an average CEO in our sample earns on annual total payments of around CHF 3.3 million, holds 1.4 percent of the company's equity capital which corresponds to CHF 18.10 million of personal wealth. However, these variables are highly skewed. The corresponding numbers for the median CEO are CHF 2 million, 0.04 percent, and CHF 1.2 million. Moreover, Figure 1 plots the mean and median levels of real total CEO pay over the sample period, split into corresponding stock indices.

A first striking finding is that mean CEO pay doubles from one index bracket to the next. An average CEO of a SMI company earns twice the remuneration that the CEO of an average Mid-Cap company earns. And the CEO of a Mid-Cap companies receives almost twice the pay that a Small-Cap CEO obtains.

Table I

Summary Statistics: CEO annual Pay Variables and Firm Characteristics

This table presents summary statistics of the main variables capturing the CEO pay and firm characteristics. *BASE PAY* represents the total sum of guaranteed annual cash pay. *VARIABLE CASH* is the total variable cash bonus. *LTIP* is the total sum of the payments granted in long-term-incentive programmes (containing fix and variable equity payments). *OTHER PAY* captures granted benefits, and emoluments for management service as well pension contributions. *TOTAL PAY* is the sum of total fixed cash and equity pay, variable cash and equity pay, and total other granted remuneration. *ASSETS* captures the sum of total firm assets. *FOREIGN SALE* is the ratio of international sales to the company's domestic sale. *BETA* is the stock related movements in its price relative to movements in the market as a whole. *EBITDA* represent the earnings of a company before interest expense, income taxes and depreciation. It is calculated by taking the pretax income and adding back interest expense on debt and depreciation, depletion and amortization and subtracting capitalized interest. *EBIT* represents the earnings of a company before interest expense and income taxes. *ROA* (return on assets) is the ratio of EBITDA divided by the firm's total assets. *ROE* (return on equity) is the ratio of EBITDA divided by shareholder's equity. *TOTAL RETURN* is the total return of holding the company's equity over the last year and re-investing all dividend payments to purchase additional units of the equity. EPS captures the earnings per share. *NO OF DIRECTORS* is the total number of directors in the company's board, and *NO OF EXECUTIVES* represents the total number of executives. *EQUITY OWNED* is the absolute number of shares held by the corresponding CEO divided by the total number of outstanding shares. *VALUE SHAREHOLDINGS* captures the value of the CEO's shareholdings; calculated by valuing the shareholdings by the share price at the end of each corresponding year. *DISCLOSURE SCORE* represents the score of the disclosure analysis. *SPI RETURN* is the annual return of the Swiss Market Index, and *SECTOR IND RETURN* captures the returns of different sector indices. *EXPORT PI* is a price index that measures the producer price level of goods sold for export. All firm return variables have been winsorized at the 2.5th and 97.5th percentiles.

Panel A: CEO pay and wealth variables	Mean	p25	p50	p75	min	max	sd
BASE CASH PAY (in TCHF)	954.77	451.00	684.00	1,110.44	0.00	7,908.12	972.10
VARIABLE CASH (in TCHF)	725.01	109.00	364.96	840.00	0.00	6,776.14	1,025.35
LTIP (in TCHF)	1,260.32	24.00	300.28	1,300.00	0.00	17,900.00	2,485.59
OTHER PAY (in TCHF)	358.09	82.90	171.00	293.75	0.00	13,485.80	970.99
TOTAL PAY (in TCHF)	3,318.08	1,076.00	1,993.00	4,073.98	0.00	22,280.00	3,603.75
EQUITY OWNED (in %)	1.40	0.00	0.04	0.18	0.00	61.78	6.17
VALUE SHAREHOLDINGS (in TCHF)	18,163.01	62.70	1,158.40	5,032.22	0.00	921,634.60	74,134.55
Panel B: Firm characteristics							
ASSETS (in Mio.)	49.35	1.05	3.15	18.19	0.02	2,269.55	214.63
FOREIGN SALE (in %)	46.13	17.35	46.02	74.46	0.00	99.76	32.38
BETA	1.17	0.75	1.25	1.54	0.01	2.16	0.52
EBITDA (in Mio.)	1.33	0.10	0.31	0.65	-0.14	14.90	3.20
EBIT (in Mio.)	1.10	0.06	0.23	0.55	-0.17	12.58	2.68
Panel C: Performance measures							
ROA (in %)	6.03	1.20	5.33	10.27	-15.45	23.64	7.64
ROE (in %)	10.66	6.57	12.01	19.07	-63.68	44.40	18.11
TOTAL RETURN (in %)	-0.85	-27.35	-0.47	21.86	-72.57	97.57	39.52
EPS (in %)	17.02	1.76	5.57	15.71	0.00	160.60	31.19
Panel D: Governance Measures							
NO OF DIRECTORS	8.82	7.00	8.00	10.00	4.00	20.00	2.90
NO OF EXECUTIVES	7.72	5.00	7.00	9.92	1.00	29.00	4.18
DISCLOSURE SCORE (in %)	60.89	47.73	63.64	76.19	11.90	100.00	18.96
Panel E: Market Measures							
SECTOR IND RETURN (in %)	-3.93	-20.41	-2.30	21.65	-75.53	46.51	27.70
EXPORT PI (in BP)	100.87	100.60	101.00	101.80	98.30	102.60	1.46
SPI RETURN (in %)	-3.17	-7.72	-0.05	2.92	-34.05	23.18	18.69

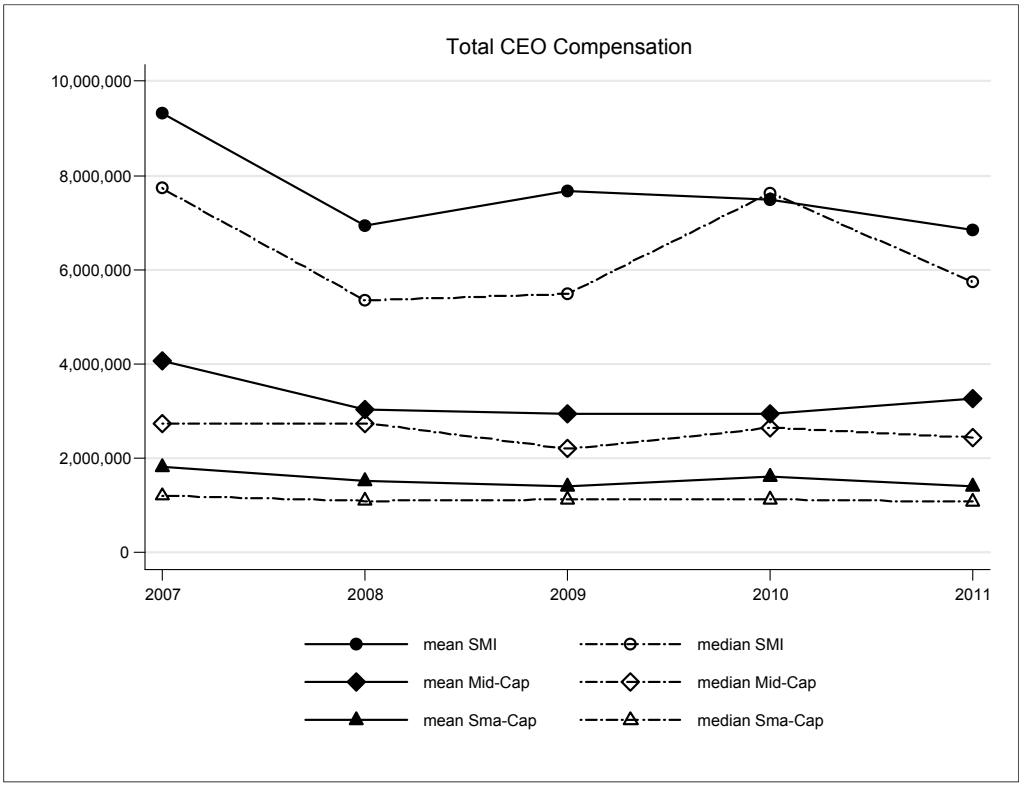

Figure 1. Total CEO compensation. This figure depicts the per capita CHF levels of annual total CEO compensation over the sample period. The mean and median levels are split according to different company size classes, where *SMI*, *Mid-Cap* und *Sma-Cap* capture Swiss Market Index constituents, Mid-Cap and Small-Cap firms, respectively.

This pattern remains constant over the whole sample period.

Second, consider the development over time. Strikingly, average CEO pay in SMI companies decreased by at least 20 percent over the time period under consideration; the largest cut emerged between 2007 and 2008, presumably as a direct consequence of the subprime crisis. Beside this crisis effect there seems to occur no other common pattern in general annual remuneration characteristics. Hence, solely CEOs of SMI companies increase their total pay in 2009 whereas average CEO pay in the other sectors showed a continued downward sloping trend. Finally, Figure 1 demonstrates that SMI CEO remuneration is more volatile over time than compensation in the two smaller indices.

3.2. Composition of CEO Pay

Figure 2 presents the composition of CEO pay, separated into different index brackets. Thus, we calculate the stake of each pay component (base cash pay,

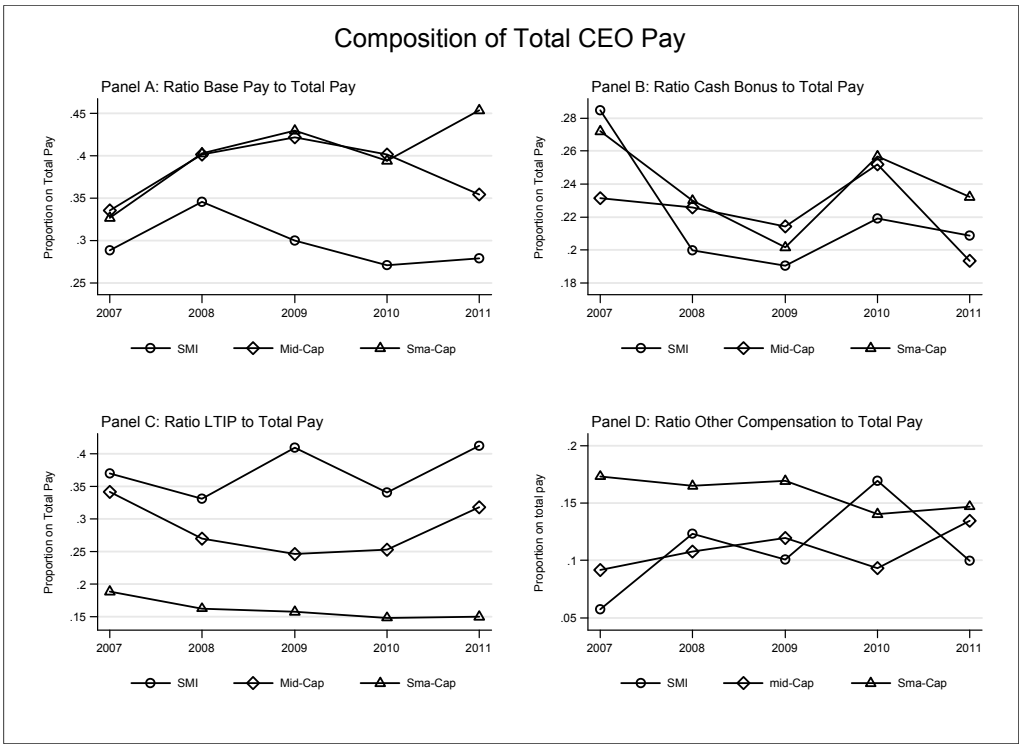

Figure 2. Composition of total CEO Compensation. This figure displays the composition of CEO pay over the sample period. Each of the pay components are presented separately according to company size, where *SMI*, *Mid-Cap* und *Sma-Cap* capture Swiss Market Index constituents, Mid-Cap and Small-Cap firms, respectively. Panel A depicts the sum of total base pay to total pay. Panel B: presents the ratio of the cash bonus to total pay and Panel C the LTIP (long term incentive payment), base and variable equity participation payments to total pay. Panel D displays the sum of all other payments, such as consulting fee or pension contribution payments, to total pay.

cash incentive pay (bonuses), equity incentive pay (long-term incentive plans and options) and other payments) on total annual compensation.

An inspection of Panel A of Figure 2 reveals a decreasing importance of fix cash payments for CEOs of larger firms. Thus, CEOs of SMI firms receive about 30 per cent of their total annual reward in the form of fix cash payments; by contrast, for CEOs in Small-Cap firms, the stake of base pay even increases from 0.35 in 2007 to almost half of total annual pay in 2011.

Next, Panel B of Figure 2 depicts the share of discretionary annual short-term cash bonus on total reward. Naturally, as direct consequence of the financial crisis, there occurred a large drop in the importance of bonuses in 2008 and 2009. However, we further observe that the portion of bonus payments decreases more for CEOs of SMI companies than it did for CEOs of Mid-Cap or Small-Cap firms. Furthermore, especially SMI company CEOs record a significant loss in importance of bonuses in the years after the crisis.

Thus, the stake of bonuses on total pay decreased for SMI-company CEOs from almost one third to around one fifth in 2011.

3.3. Other Executives

Figure 3 depicts the mean and median levels of pay of the members of the executive board.[6] Overall total annual pay of executives does not exhibit large fluctuation over time. The mean levels are close to the median levels, implying that executive pay does not exhibit extremely high payments.

Interestingly, the pattern of size-dependent pay levels, previously observed for CEOs, also seems to exist for other executives. Although mean and median levels of executive pay of Small-Cap and Mid-Cap firms lie closer together, the increase in pay in SMI executive pay is striking. Thus, an average executive in a SMI firm is rewarded by more than three times the salary that an average Small-Cap executive earns.

Lastly, we observe that average executive pay levels only increase moderately over the sample period. This finding is interesting, especially after having seen substantial drops in CEO pay levels as a consequence of the recent financial crisis.

3.4. The Board of Directors

Figure 4 presents an overview of the mean and median levels of total compensation for directors in the companies' board split according to size classes.[7] Overall, average total directors' annual pay increases massively by size class. Thus, an average director can almost quadruple his average pay by moving from a Small-Cap company to a large SMI company. In other words, there are substantial incentives through career concerns for directors of Swiss companies. This pattern has remained stable over time.

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[6] This group of executives captures only these members of the executive board that are not considered as CEO.

[7] This captures only those members of the board that are not classified as Chairman.

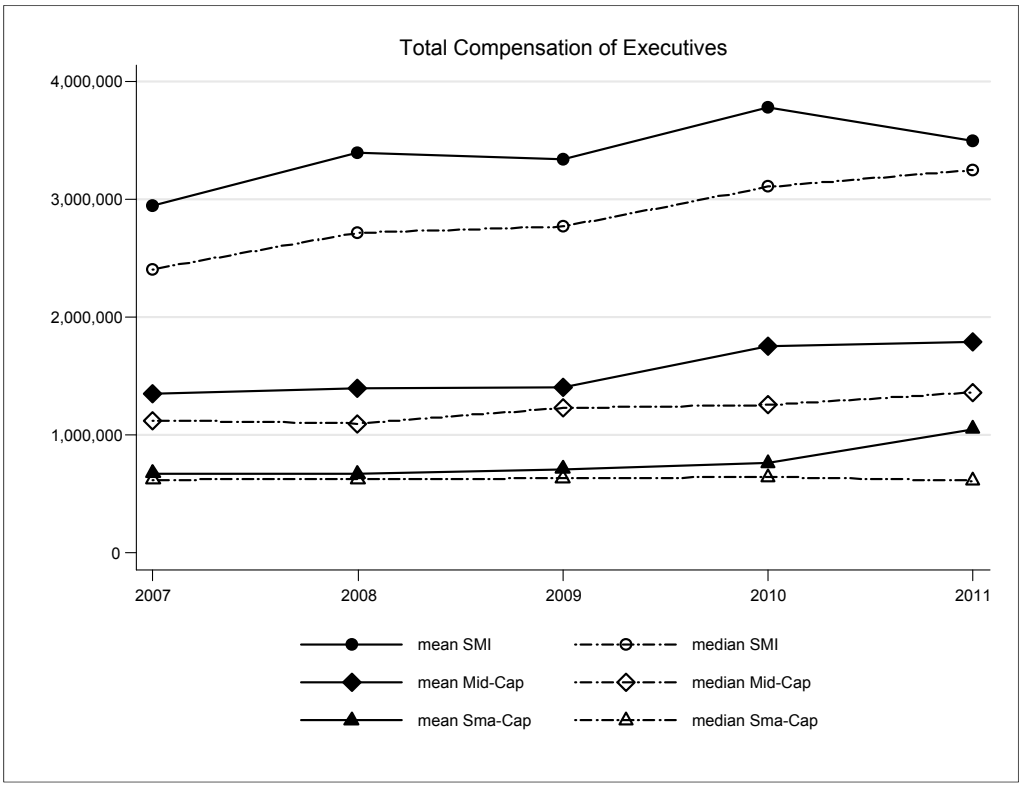

Figure 3. Total compensation of executives. This figure depicts CHF levels of annual executive board member compensation over the sample period. *Executives* are those members of the Executive Board that are not considered as CEOs. The mean and median levels are split according to different company size classes, where *SMI*, *Mid-Cap* und *Sma-Cap* capture Swiss Market Index constituents, Mid-Cap and Small-Cap firms, respectively.

Overall, between 2007 and 2011, average total director pay decreased modestly for SMI companies by 5 percent and by around 4 percent for Mid-Cap companies, respectively. In contrast, on average directors in Small-Cap firms lost around 10 per cent of their (already relatively low) annual pay since 2007. The mean-median-ratio of total director pay remains almost constant over time and is 1.02 for Small companies in 2011 and 1.5 for Mid-Cap companies in 2007. Extremely high pay levels do not tend to occur in directors' pay.

Next, Figure 5 presents the mean and median levels of total chairman compensation split into index brackets. When interpreting these figures, an important caveat has to be considered. A chairman can either solely chair the board of directors or he can – in the same function - also have additional operational responsibilities as a member or chairman of the executive board.

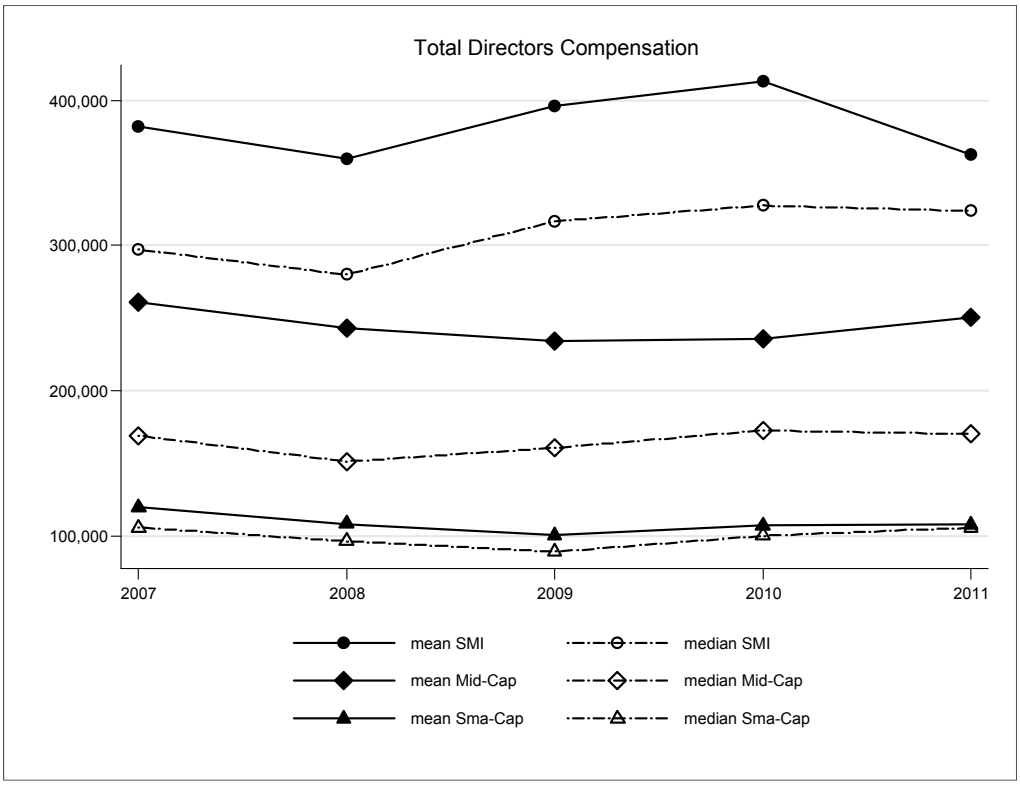

Figure 4. Total director compensation. This figure depicts the per capita CHF levels of annual directors compensation over the sample period. *Directors* capture the members of the board of directors that are not considered as Chairmen. The mean and median levels are split according to different company size classes, where *SMI*, *Mid-Cap* und *Sma-Cap* capture Swiss Market Index constituents, Mid-Cap and Small-Cap firms, respectively.

This implies that this group of directors cannot be identified as strictly as the previous subgroups were.[8] Nonetheless, some findings are noteworthy.

It is interesting to observe that SMI company Chairmen's pay was not influenced by the recent financial crisis. Strikingly, average total pay of SMI firm chairmen has even increased by around 20 percent between 2007 and 2011.

This pattern does not appear to be driven by an outlier; the median annual pay levels also increased by more than 50 per cent. This strongly contrasts with the significant decrease of total average compensation of chairmen in Mid-Cap companies. An average Chairman of a SMI company today earns more than 4.5 times the pay rewarded in Small-Cap companies.

[8] The annual surveys of PricewaterhouseCoopers, for example, attempt to distinguish between operative and non-operative Chairmen. Thus, they arrive at different descriptive statistics than presented here.

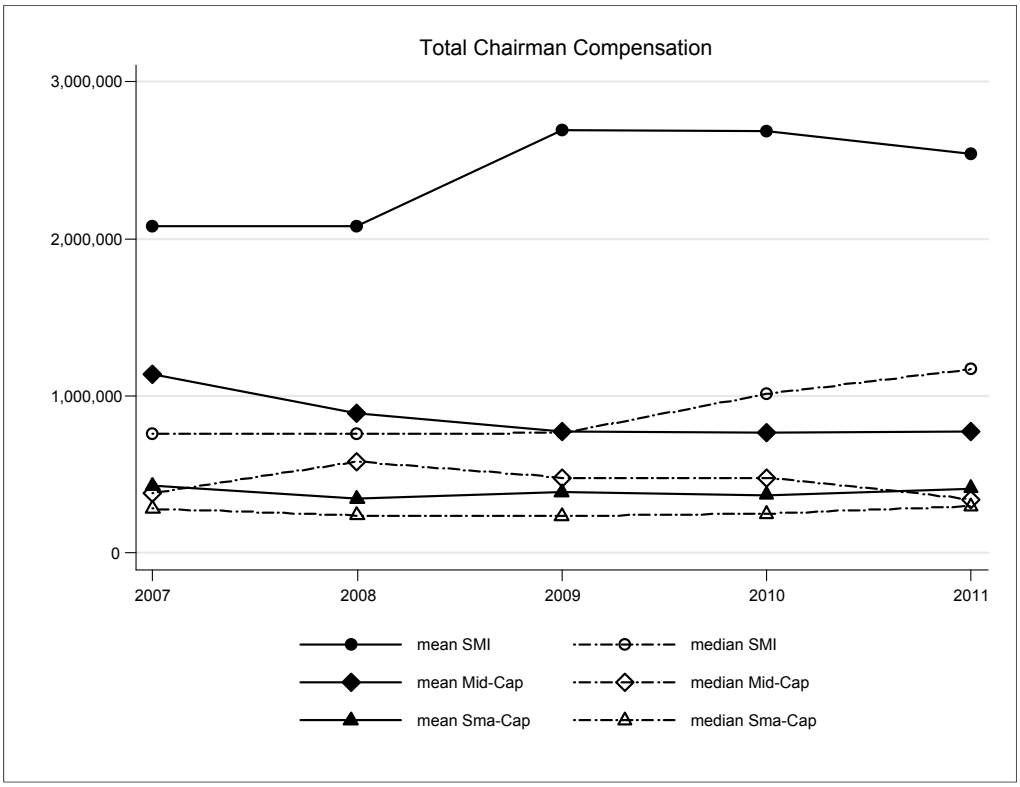

Figure 5. Total chairman compensation. This figure depicts the per capita CHF levels of annual Chairmen compensation over the sample period. The mean and median levels are split according to different company size classes, where *SMI*, *Mid-Cap* and *Sma-Cap* capture Swiss Market Index constituents, Mid-Cap and Small-Cap firms, respectively.

4. An Analysis of Pay for Performance

Having found some first potential patterns of CEO pay variation over time in the previous section, we now focus on the determinants of CEO pay in the cross section.

Given the fact that the actions of the CEO are difficult to observe by shareholders, there arises the risk that the CEO as agent expends too little effort on the principal's behalf. That is, the executive might have an incentive to work less than is optimal for shareholders as a group. In order to minimize agency-costs, executive compensation is designed to provide incentives that induce managers to act in ways to maximize firm and shareholder value.

But how strong are the actual performance-incentives for Swiss CEOs? Subsequently we study whether and how strongly managers are aligned with firm performance and to which extent CEO pay depends on factors that are beyond the CEO's control.

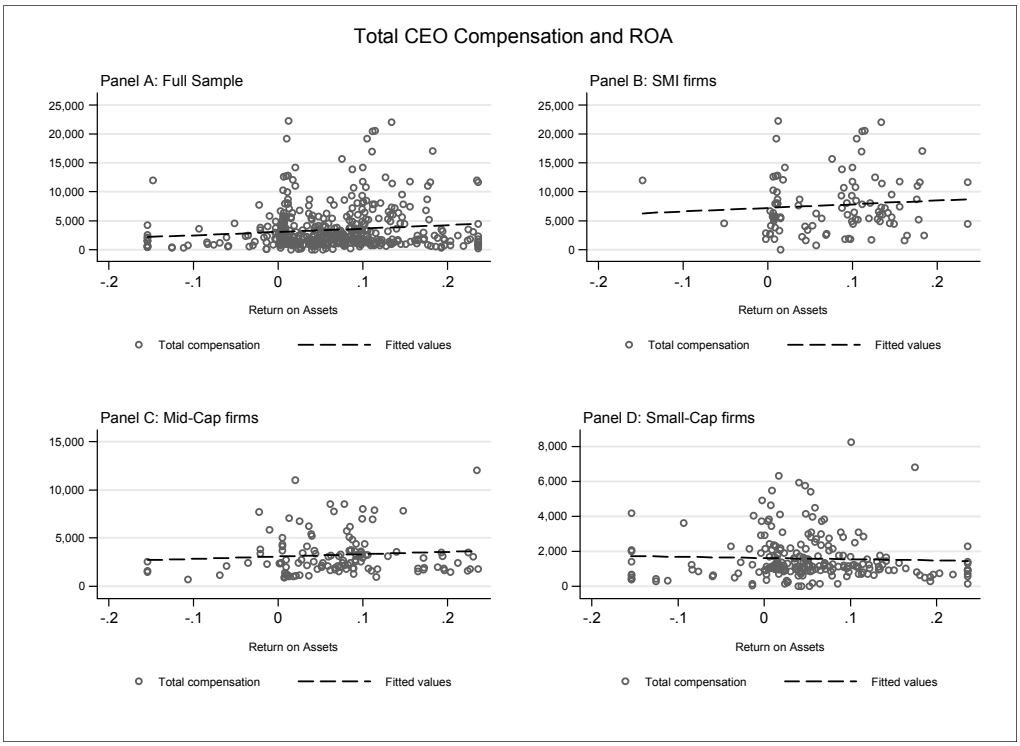

Figure 6. Total CEO compensation and return on assets. This figures presents scatter plots of total CEO compensation and contemporaneous return on assets (*ROA*). Panel A displays the plots for the overall sample, and Panel B to D depict the corresponding plots for SMI, Mid-Cap and Small-Cap firms, respectively.

4.1. Basic Results

We begin by providing some graphical evidence, simply plotting annual levels of total CEO pay against firm performance measures. Figure 6 presents scatter plots of CEO total annual remuneration and return on assets (ROA) for the overall sample as well as for different firm size brackets. Considering the overall sample first, it becomes apparent that total annual CEO pay increases slightly with increasing firm performance. An inspection of the three plots for the indices additionally suggests that this positive correlation is most pronounced for SMI companies.

Next, Figure 7 displays the analogous scatter plots for total annual CEO remuneration and return on equity (ROE). A similar pattern as with ROA arises; indeed, the correlation between performance and pay seems to be more pronounced and stronger.

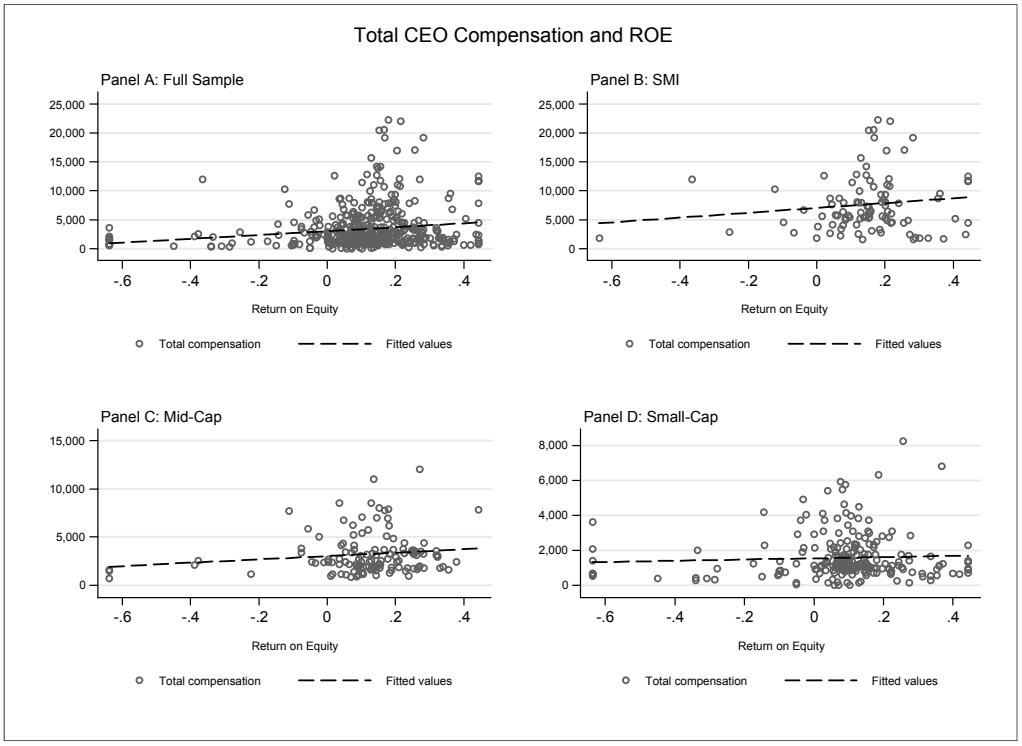

Figure 7. Total CEO compensation and return on equity. This figures presents scatter plots of total CEO compensation and contemporaneous return on equity (*ROE*). Panel A displays the plots for the overall sample, and Panel B to D depict the corresponding plots for SMI, Mid-Cap and Small-Cap firms, respectively.

These findings provide a first indication that CEOs' total annual pay is tied to firm performance, at least in large companies. We now investigate this relationship more rigorously, using regression analysis. In this analysis, we follow Jensen and Murphy (1990) and Murphy (1999). Specifically, we estimate:

$$CEO\ PAY_{ijt} = \beta\, PERFORMANCE_{it} + \gamma\, CONTROLS_{it} + \alpha_j + \delta_t + \varepsilon_{ijt} \qquad (1)$$

where $CEO\ PAY_{ijt}$ is the measure of total annual CEO compensation, which is defined as the annual total pay or components of pay of firm *i* of sector *j* in year *t*.

PERFORMANCE captures company performance and incorporates various accounting performance and shareholder return measures. The coefficient β captures the strength of the pay for performance relationship.

CONTROLS are control variables that include firm size and corporate governance proxies. Incorporating governance variables is important because

it is possible that the pay-setting process between a CEO and the board is not at arm's-length (Bebchuk and Fried (2004)). Additionally, we incorporate a static beta factor to capture the (market) risk exposure a company has against the overall market movements (Aggarwal and Samwick (1999)).

As our sample is a cross section of firms of varying sizes and industries, there are likely to exist time invariant unobservable factors which may explain some part of the variation in pay. We try to address this unobserved heterogeneity by incorporating time and sector-specific binary variables. Hence, α_j refers to sector-specific effects of sector j. δ_t represents a set of year dummies, capturing possible time trend and macroeconomics shocks that are common to all firms.

Moreover, we take logs of total compensation and the key explanatory variables. Thus, the regression estimates may be interpreted as elasticities.

We note that these regressions do not allow us to strictly identify causal effects, as there are possible omitted variables correlated with both compensation and the explanatory variables. Therefore, we interpret the results are correlations.

Table II presents the main results of the CEO pay-for-performance panel regressions. Overall, the analysis confirms the indications we derived from the scatters plots: Total annual compensation of Swiss CEOs is significantly positively associated with firm performance.

Consider first the regressions where performance is measured by contemporaneous return on assets, as in specifications (1) to (3). The inspection reveals that there is a positive, significant link between ROA and total compensation. The economic significance is not very large, however; a 10% increase in return on assets is associated with a 1.2 per cent increase in total pay.

Next, performance is captured by total return on equity, Columns (4) to (6). It becomes apparent that the pay-performance elasticity becomes even stronger. Thus, a 10 per cent increase in ROE is rewarded by around 5 per cent increase in total pay. Our finding suggest that for an average CEO of an average average firm in our sample, an increase of ROE from 10.6% to 11.7%

Table II

Pay for Performance

This table presents panel regressions of CEO total compensation on performance and control variables. The dependent variable is the logarithm of the CEO total compensation defined as the sum of base pay, bonus, the long-term incentive payments and the value of other granted remuneration in the given year. CEO pay is reported in CHF. *ln(ROA)* (return on assets) is the logarithm of the ratio of earnings before interest, taxes, depreciation, and amortization (EBITDA), divided by the firm's total assets. *ln(ROE)* is the logarithm of the ratio of EBITDA divided by shareholder's equity. *ln(TOT_RET)* is the logarithm of the total return of holding the share of the company over the last year; this assumes that dividends are re-invested to purchase additional units of the equity. *NO OF DIRECTORS* captures the total number of directors in the company's board. *EQUITY OWNED* is the absolute number of shares held by the corresponding CEO divided by the total number of outstanding shares. *BETA* is a static factor capturing the stock related movements in its price relative to movements in the market as a whole. *ln(TOTAL ASSETS)* is the logarithm of the firm's total assets, reported in CHF. *Sector Controls* are binaries that equal one for each of different industry sectors the corresponding company is assigned by the Swiss stock exchange. The t-statistics are adjusted for clustering of standard errors by firm. ∗, ∗∗, and ∗∗∗ indicate significance at the 10%, 5%, and 1% levels, respectively. Time and industry dummies are included but not reported.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ln(1+ROA)	0.113*	0.120*	0.113*							
	(1.72)	(1.85)	(1.71)							
ln(1+ROE)				0.506**	0.496**	0.502**				
				(2.24)	(2.14)	(2.22)				
ln(1+EBITDA)							0.052	0.058		
							(1.31)	(1.41)		
L.ln(TOTAL RETURN)									0.143**	0.136**
									(2.23)	(2.18)
NO OF DIRECTORS		-0.020			-0.011			-0.029		0.017
		(-0.78)			(-0.41)			(-1.04)		(0.82)
EQUITY OWNED			0.006			-0.784		-0.700		-0.507
			(0.01)			(-1.35)		(-0.94)		(-0.60)
BETA	0.267*	0.263	0.267*	0.250*	0.246	0.254*	0.222	0.217	0.357**	0.363**
	(1.69)	(1.64)	(1.70)	(1.68)	(1.62)	(1.71)	(1.41)	(1.36)	(2.23)	(2.26)
ln(TOTAL ASSETS)	0.266***	0.288***	0.266***	0.246***	0.257***	0.241***	0.269***	0.293***	0.392***	0.368***
	(2.88)	(2.99)	(2.82)	(3.16)	(3.09)	(3.03)	(2.86)	(2.92)	(10.23)	(7.77)
Constant	7.600***	7.494***	7.601***	8.095***	8.064***	8.171***	7.864***	7.840***	5.876***	6.020***
	(5.35)	(5.31)	(5.24)	(6.73)	(6.71)	(6.68)	(5.43)	(5.37)	(9.34)	(8.96)
Sample Size	414	414	414	459	459	459	413	413	279	279
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.32	0.32	0.32	0.33	0.33	0.33	0.30	0.29	0.56	0.56

implies an increase of total CEO pay by around CHF 165,000.

Columns (7) and (8) indicate that financial measures, here shown for EBITDA, are still positively, but less significantly associated with performance. This suggests that they are not perceived as an adequate measure of performance or are not used to reward performance. Further

untabulated results confirm that this finding also holds for other accounting measures (earnings per share, dividend per share) and financial measures (level or change in earnings or sales).

Finally, Columns (9) and (10) provide evidence for a direct alignment of shareholders' interests and CEO pay. A 10% increase in total shareholder return in the previous year is associated with a 1.4 per cent increase of total CEO pay.

As for the control variables, naturally, firm size has a large effect on total CEO pay. In the regressions measuring company performance by the return on asset, the total assets' elasticity is around 0.25. This implies that a 10% increase in total assets will lead to a 2.5% increase in total annual CEO pay. Interestingly, concerning the governance variables, we are not able to find any significant effect. Thus, neither a larger board nor the proportion of equity owned by the CEO seem to determine CEO total annual pay. The insignificance of both governance variables indicates that there seems to exist no entrenchment in Swiss boards and CEO's are not able to take significant control in the pay-setting process.

The static beta factor enters positively and significantly in almost all specifications. Thus, as expected, total CEO pay increases with the exposure of the corresponding company to the general market. We interpret this finding as a risk premium – being more exposed to market movements is something a risk-averse CEO needs to be compensated for.[9]

Table III tabulates year dummies for the overall sample, split for different indices and into sectors. Panel A of Table III shows that controlling for the various firm-specific variables, there does not seem to exist an overall fix year effect influencing annual total CEO pay. Solely the technology company sector exhibits a significant downward trend. Additionally, Panel B of Table III displays the time dummy coefficients for a regression of total annual CEO on time dummies only. Here, the time effects are somewhat more pronounced,

[9] Another channel through which beta may influence pay is through the increased dismissal risk for the CEO. Indeed, Peters and Wagner (2012) document that CEOs of firms exposed to more volatile industry conditions are more likely to be fired, and are consequently paid a job risk premium.

Table III

Time Dummy Coefficients

This table presents time dummy coefficients from panel regressions; Panel A displays the time dummy coefficients of model (1) inTable 1 and Panel B presents the time dummy coefficients of a panel regression on time dummy coefficients only. The Year 2007 is the reference year, and *Overall* captures the entire sample of CEO observations; *SMI* and *MID-CAP* consider subsamples according to the corresponding Swiss stock exchange index. *SMA-CAP* comprises companies of smaller market capitalization, i.e. not being part of either the *SMI* or *MID-CAP* index. Column (5) to (11) split the sample into different sectors, where *Indi* captures industrial companies, *Fina*, *Bama*, *Heca*, *Cogo*, *Tech*, and *CoSE*, financials, basic material, health care, consumer goods, technology and consumer service sector firms, respectively.
The t-statistics are adjusted for clustering of standard errors by firm. ∗, ∗∗, and ∗∗∗ indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Overall	SMI	MID-CAP	SMA-CAP	Indu	Fina	Bama	Heca	Cogo	Tech	Cose
Panel A: Time dummy of corresponding specification (1) in Table 2.											
2008	-0.059	-0.096	-0.130	-0.040	0.032	-0.140	0.475	-0.191	0.044	-0.222*	-0.282
	(-0.92)	(-0.75)	(-1.13)	(-0.46)	(0.35)	(-0.92)	(1.57)	(-0.90)	(0.43)	(-1.70)	(-0.77)
2009	-0.049	0.029	-0.244*	0.004	-0.005	0.142	0.414	-0.232	0.017	-1.179**	-0.351*
	(-0.58)	(0.32)	(-1.95)	(0.04)	(-0.04)	(0.84)	(0.99)	(-1.20)	(0.09)	(-2.48)	(-1.72)
2010	0.004	0.019	-0.134	0.035	0.157	0.085	0.288	-0.182	0.008	-0.551*	-0.242
	(0.05)	(0.16)	(-0.99)	(0.30)	(1.46)	(0.48)	(1.16)	(-0.64)	(0.04)	(-1.69)	(-1.18)
2011	0.008	0.012	0.038	-0.018	0.238*	0.020	0.238	-0.183	0.191	-0.560***	-0.239
	(0.10)	(0.08)	(0.31)	(-0.14)	(1.83)	(0.10)	(0.95)	(-0.66)	(1.10)	(-5.27)	(-1.16)
Sample Size	414	100	111	203	110	129	28	51	35	26	20
Sector Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.32	0.15	0.38	0.28	0.024	0.38	0.75	0.85	0.67	0.59	0.70
Panel B: Time dummy coefficients of regression of CEO total pay on time dummies only											
2008	-0.091	-0.243	-0.211**	-0.017	0.001	-0.192	0.035	-0.242	0.014	-0.149	-0.041
	(-1.41)	(-1.40)	(-2.25)	(-0.20)	(0.01)	(-1.12)	(0.13)	(-1.33)	(0.13)	(-1.17)	(-0.10)
2009	-0.067	-0.134	-0.299**	0.023	-0.080	0.104	0.005	-0.075	-0.062	-0.782*	-0.433
	(-0.83)	(-1.26)	(-2.45)	(0.20)	(-0.71)	(0.56)	(0.02)	(-0.35)	(-0.51)	(-1.91)	(-1.57)
2010	0.008	-0.096	-0.157	0.072	0.183	0.044	-0.075	-0.230	-0.074	-0.347	0.007
	(0.10)	(-0.73)	(-1.29)	(0.62)	(1.64)	(0.22)	(-0.33)	(-0.83)	(-0.45)	(-1.35)	(0.03)
2011	-0.020	-0.139	-0.090	0.007	0.203*	-0.060	-0.139	-0.302	0.017	-0.183*	0.127
	(-0.25)	(-0.86)	(-0.73)	(0.06)	(1.67)	(-0.28)	(-0.37)	(-1.11)	(0.09)	(-1.79)	(0.50)
Sample Size	477	103	129	245	118	143	30	65	36	32	31
Sector Controls	No	No	No	No	No	No	No	No	No	No	No
R^2	0.00	0.01	0.03	0.00	0.00	0.00	0.03	0.01	0.01	0.13	0.17

suggesting that the firm-specific variables explain significant variation over time that is otherwise captured by the time dummies directly.

In order to confirm this, we consider the ratio of explained variation in different settings by comparing both panels of Table III. Indeed, the major part of variation in total CEO pay is captured by firm size and sector index

variables. Thus, we conclude that our analysis does not provide evidence for the existence of common factors, such as regulatory influences, that determine the levels of CEO pay in general.

Overall, this analysis shows that CEO pay in Swiss companies is powerfully determined by the performance of the companies and sectors. By contrast, variation in governance measures offers limited power in explaining variation in pay.

4.2. Heterogeneous Effects

After having found evidence for a connection of pay and performance in the previous section, we now evaluate whether there occur size effects in the interaction of pay and performance. In Table IV we interact the raw performance measures with size variables.

In Columns (1) to (3) of Table IV we interact performance measures with total assets – our primary firm size variable. An inspection of Table IV appears to suggest that the previously established pay for performance sensitivity does not seem to be determined by size effects. None of the performance measures shows any significant interaction with the firm's asset size.

However, it turns out that there is a non-linear relation between firm size and pay-for-performance. Specifically, in Columns (4) to (6) we interact the performance measures with a binary indicator variable that equals one for Small-Cap companies and that is zero otherwise. An inspection of Column (4) reveals a massive decrease in the pay for performance sensitivity for Small-Cap firms. While a 10 per cent increase in return on assets increases the annual pay of CEOs in SMI and Mid-Cap firms on average by around 3 percent, the pay for performance sensitivity in Small-Cap firms virtually vanishes to about 0.02 percent. Similar results, though somewhat less significantly, also hold for the other performance measures that had been shown to be significant determinants of pay, ROA and ROE.

Overall, pay for performance appears to be most pronounced in large and medium Swiss companies, but is essentially non-existent in small firms.

Table IV

Heterogeneous Effects

This table presents panel regressions of CEO total compensation on performance and control variables. The dependent variable is the logarithm of the CEO total compensation defined as the sum of salary, bonus, the long-term incentive payments and the value of other granted remuneration in the given year. CEO pay is reported in CHF. *ln(1+ROA)* (return on assets) is the logarithm of the ratio of earnings before interest, taxes, depreciation, and amortization (EBITDA), divided by the firm's total assets. *ln(1+ROE)* is the logarithm of the ratio of EBITDA divided by shareholder's equity. *ln(TOTAL RETURN)* is the logarithm of the total return of holding the company's stock over the last year; this assumes that dividends are re-invested to purchase additional units of the equity. *ln(STOCK RETURN)* is the logarithm of the return of the firm's stock in the current year. *NO OF DIRECTORS* captures the total number of directors in the company's board. *EQUITY OWNED* is the percentage of the firm's equity owned by the CEO. *BETA* is a static factor capturing the stock related movements in its price relative to movements in the market as a whole. *SMA-CAP* is a dummy variable that equals to one for companies considered as "small", i.e. not being part of either the *SMI* or *SMIM* index. *ln(TOTAL ASSETS)* is the logarithm of the firm's total assets, reported in CHF. The t-statistics are adjusted for clustering of standard errors by firm. ∗, ∗∗, and ∗∗∗ indicate significance at the 10%, 5%, and 1% levels, respectively. Time and industry dummies are included but not reported.

	(1)	(2)	(3)	(4)	(5)	(6)
ln(1+ROA)	-0.665			0.294***		
	(-0.85)			(3.37)		
ln(1+ROE)		-0.771			0.910**	
		(-0.55)			(2.51)	
L.ln(TOTAL RETURN)			0.037			0.211***
			(0.10)			(2.96)
ln(1+ROA) * ln(TOTAL ASSETS)	0.053					
	(0.99)					
ln(1+ROE) * ln(TOTAL ASSETS)		0.086				
		(0.91)				
L.ln(TOTAL RETURN) * ln(TOTAL ASSETS)			0.007			
			(0.29)			
SMA-CAP				0.653*	0.119	-0.521***
				(1.79)	(0.42)	(-2.99)
ln(1+ROA) * SMA-CAP				-0.276**		
				(-2.36)		
ln(1+ROE) * SMA-CAP					-0.653	
					(-1.44)	
L.ln(TOTAL RETURN) * SMA-CAP						-0.101
						(-1.37)
ln(TOTAL ASSETS)	0.195	0.260***	0.370***	0.301***	-0.010	0.291***
	(1.36)	(3.03)	(7.76)	(2.77)	(-0.39)	(5.62)
NO OF DIRECTORS	-0.019	-0.010	0.017	-0.019	0.292*	0.013
	(-0.76)	(-0.38)	(0.84)	(-0.79)	(1.75)	(0.69)
BETA	0.339*	0.253*	0.366**	0.389**	-0.935	0.255*
	(1.91)	(1.67)	(2.27)	(2.18)	(-1.52)	(1.76)
EQUITY OWNED	-0.105	-0.769	-0.483	-0.109	0.262***	-0.255
	(-0.16)	(-1.32)	(-0.58)	(-0.18)	(2.79)	(-0.31)
Constant	8.802***	8.010***	5.984***	6.767***	7.846***	7.800***
	(4.47)	(6.41)	(8.94)	(3.73)	(5.11)	(9.35)
Sample Size	414	459	279	414	459	279
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector Controls	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.33	0.34	0.56	0.31	0.33	0.58

4.3. Pay for Luck

In this section we try to obtain further insights in the contracting relationship between the CEO and the board. Specifically, having documented that pay and measures of firm performance are related, we now turn to the question of which part of firm performance is actually rewarded. Following Bertrand and Mullainathan (2001), we consider firm performance as being split into a part that actually depends on the factual action of the CEO and of another random, but observable component that is external to the CEO.

This random component of performance consists of other factors that are beyond the control of the CEO. As the CEO has no control over the observable luck components, the shareholder does not profit at all from incentivizing the CEO on this component. Hence, an optimal incentive scheme should filter for observable luck components.[10]

In order to estimate the sensitivity of CEO pay to luck, we apply a two-stage procedure where luck is the instrument for performance. In the first-stage we predict performance by regressing the previously found pay-performance sensitivity measures on variables capturing unobservable luck components:

$$PERFORMANCE_{ijt} = b\, FAVORABLE_{it} + g\, CONTROLS_{ijt} + d_i + e_{it} \quad (2)$$

Where *PERFORMANCE* is the measure of firm performance of firm *i* of sector *j* in year *t* and $FAVORABLE_{it}$ captures the measure for luck; the predicted value of performance is $\widehat{PERFORMANCE}_{ijt}$.

As the Swiss economy is mainly export oriented, we consider the direct influence of exchange rate movements as a first measure of luck. We call this specification EXCHANGE. Here, we define *FAVORABLE* as the *FOREIGN SALES* of each firm multiplied by the *EXPORT PRICE INDEX*. Thus an

[10] These predictions hold within the strict confines of traditional agency theory. Some models do predict that even in competitive markets pay should depend on industry and general market factors. See, for example, Eisfeldt and Kuhnen (2010).

increase in *FAVORABLE* indicates a more prosperous external environment to the company and, hence, an increase in performance.

As a second luck measure we consider the stock return of the domestic sector each company belongs to. The underlying assumption is that sector affiliation is not determined by the CEO and performance is mainly driven by factors that are beyond the control of the CEO. We call this specification SECTOR. Here, *FAVORABLE* is equal to the sector return, which again is hypothesized to be positively related to firm performance.

Then, in the second-stage of our pay for luck regression we incorporate the predicted values for firm performance that are solely determined by corresponding the luck measure. Then, we estimate the pay-performance elasticity regression again:

$$CEO\ PAY_{ijt} = \beta_{Luck}\ \widehat{PERFORMANCE}_{ijt} + \gamma\ CONTROLS_{it} + \delta_t + \varepsilon_{ijt} \quad (3)$$

where $\widehat{PERFORMANCE}_{ijt}$ captures the predicted value of $PERFORMANCE_{ijt}$. Naturally, we omit the sector dummies from this analysis because foreign exposure and sector performance are highly correlated with these dummies.

Since in the second-stage changes of pay are solely based on luck, we expect that estimated pay-performance coefficient, β_{Luck}, should equal to zero.

The first-stage regressions are contained in Appendix 1. The instrumental variables are significantly associated with the endogenous variables. Specifically, when the exchange rate environment becomes more favorable in the regions a company exports to more, firm performance improves. Similarly, when the sector an industry operates in does better, so does the individual company. The first-stage F-statistics for the EXCHANGE specification are between 9.5 and 15 and by around 5 for specification SECTOR (except in the case of ROE, where they are very low). We note that the values for the EXCHANGE specification are above the conventionally suggested threshold

of 10.[11] For the SECTOR specification, by contrast, we cannot exclude the possibility that our two-stage regressions are suffering from a weak instruments problem, which would bias the second-stage estimates in the same (unknown) direction as the OLS estimates are biased. We therefore interpret the following findings carefully (but note that in the study of Bertrand and Mullainathan (2003), which employs the same methodology, the F-statistics of the excluded instruments are only around 3).

The second-stage regression for specification EXCHANGE are presented in Table V. Overall, the analysis reveals that pay for luck seems to exist in Swiss CEO pay. Columns (1) and (2) in Panel A of Table V show high significance of both pay-performance coefficient. Thus, CEOs are rewarded for an increase in firm performance independent of whether they contributed by own commitment. Panel B in Table V further supports our finding and displays that CEO's total pay increases by around 0.5 per cent when return on equity increases by 1 per cent. However, an increase in return driving by luck is associated with an increase in total pay by around 11 percent. (We caution that the empirical strategy here relies on the notion that the instrumental variable is uncorrelated with other unobserved variables. It is conceivable, for example, that CEO skill, which is by nature unobserved, is positively correlated with a company's decisions to be active in foreign markets. In this case, differences in returns and differences in compensation may be driven by this unobserved dimension of heterogeneity among firms.)

Moreover, Table V reveals that especially long-term incentive plans are largely determined by pay for luck. We interpret this finding by observing that long-term incentive programmes are granted primarily on a discretionary basis. This could potentially enable the CEO to influence the arrangement in a more favorable manner.[12]

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[11] Stock, Wright, and Yogo (2002) suggest a threshold of 8.96 in the case of one instrument. This threshold applies for the case of iid errors. As we cluster standard errors by groups, we report the Kleibergen-Paap rk statistic. Here, the Staiger and Stock (1997) threshold, 10, is in practice considered as a good rule of thumb

[12] This analysis shows an additional feature of the pay-performance relation. In general, performance measures seem to be solely associated with total pay and LTIP variable components. In contrast, variable cash and base pay seem to be determined by other firm-specific characteristics.

TABLE V
PAY FOR LUCK - EXCHANGE

This table provides results of 2SLS regressions explaining CEO Pay. The dependent variable is the logarithm of CEO pay, where *TOTAL COMP* captures annual total compensation, *BASE CASH PAY* represents the sum of guaranteed cash remuneration, *VARIABLE CASH* is the amount of cash bonus payments, and *LTIP* is the sum of long-term-incentive programme (containing fix and variable equity payments). Specification captures whether the regressions were run in the general pay-performance setting (General) or as 2SLS-regression (Exchange), where performance was instrumented with FAVORABLE, a measure of the firm's foreign exposure. *NO OF DIRECTORS* captures the total number of directors in the company's board. *EQUITY OWNED* is the absolute number of shares held by the CEO divided by the total number of outstanding shares, and *BETA* is a static factor capturing the stock related movements in its price to movements in the market as a whole. *ln(TOTAL ASSETS)* is the logarithm of the firm's total assets, reported in CHF. The t-statistics are adjusted for clustering of standard errors by firm, and ∗, ∗∗, and ∗∗∗ indicate significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variable	ln(TOTAL PAY)		ln(BASE CASH PAY)		ln(VARIABLE CASH)		ln(LTIP)	
Specification	General	Exchange	General	Exchange	General	Exchange	General	Exchange
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A:Performance captured by return on assets.								
ln(1+ROA)	0.144**	1.700***	0.017	2.872	0.456	2.102	1.377***	4.385**
	(2.24)	(3.50)	(0.16)	(1.63)	(1.11)	(1.07)	(3.01)	(2.26)
NO OF DIRECTORS	-0.017	-0.075	-0.125	-0.154	-0.186	-0.400	0.086	-0.169
	(-0.67)	(-1.28)	(-1.19)	(-0.67)	(-0.85)	(-1.24)	(0.51)	(-0.71)
EQUITY OWNED	-0.362	1.292	0.078	3.965	-3.310	0.310	-15.862***	-13.578***
	(-0.72)	(0.57)	(0.06)	(1.00)	(-0.51)	(0.05)	(-4.88)	(-2.88)
BETA	0.206	0.620***	0.565	1.237**	-0.410	-0.177	0.426	1.053
	(0.96)	(2.91)	(1.38)	(2.02)	(-0.55)	(-0.22)	(0.55)	(1.15)
ln(TOTAL ASSETS)	0.237***	0.693***	0.311**	1.079*	0.244	0.886	0.872***	1.879***
	(3.65)	(4.36)	(2.14)	(1.72)	(0.89)	(1.27)	(3.32)	(2.94)
Constant	10.543***	0.434	8.084***	-9.979	8.361**	-3.325	-6.716	-26.993**
	(10.47)	(0.13)	(4.12)	(-0.82)	(2.08)	(-0.26)	(-1.53)	(-2.13)
Sample Size	414	414	414	414	414	414	414	414
Adjusted R^2	0.18		0.030		0.032		0.14	
F-stat of excluded instrument		15.01		15.01		15.01		15.01
Panel B:Performance captured by return on equity.								
ln(1+ROE)	0.491**	11.075***	-0.176	18.277	4.310***	17.892	2.921*	28.687**
	(2.17)	(2.74)	(-0.48)	(1.50)	(2.73)	(1.41)	(1.65)	(2.01)
NO OF DIRECTORS	-0.006	0.184*	-0.115	0.278	-0.081	-0.015	0.210	0.557*
	(-0.21)	(1.84)	(-1.26)	(1.31)	(-0.39)	(-0.05)	(1.16)	(1.88)
EQUITY OWNED	-1.151***	1.491	-1.232	4.542	-5.703	-2.379	-14.988***	-11.945*
	(-2.94)	(0.66)	(-0.72)	(1.02)	(-1.29)	(-0.50)	(-3.76)	(-1.95)
BETA	0.177	1.003***	0.573	1.936**	-0.466	0.541	0.036	1.964*
	(0.84)	(3.08)	(1.43)	(1.98)	(-0.62)	(0.51)	(0.04)	(1.84)
ln(TOTAL ASSETS)	0.189***	-0.105	0.276**	-0.297	0.155	-0.120	0.386	-0.286
	(3.19)	(-0.50)	(2.39)	(-0.69)	(0.68)	(-0.27)	(1.46)	(-0.48)
Constant	11.408***	11.983***	8.633***	10.045**	8.879***	9.781**	2.410	4.013
	(13.29)	(4.63)	(5.73)	(2.13)	(2.98)	(2.44)	(0.61)	(0.58)
Sample Size	459	459	459	459	459	459	459	459
Adjusted R^2	0.16		0.028		0.060		0.12	
F-stat of excluded instrument		9.515		9.515		9.515		9.515

Table VI presents the second-stage regressions for specification SECTOR. Primarily CEOs' total pay seems to be strongly associated with firm performance driven by sector performance. While considering the above-stated caveats, we observe that Swiss CEO are also exposed to sector-driven performance – both on the upside and on the downside – that is beyond their control.

5. Executive and Board Wealth and Ownership

Equity holdings can provide powerful performance incentives by ensuring that the wealth of most CEOs varies strongly with their firm's stock price.

5.1. Descriptive Statistics

Over all observations and sample periods CEO's of Swiss firms hold on average 1.4 percent of outstanding share capital. CEOs of SMI companies hold a smaller proportion of total equity capital than CEO's in Mid-Cap and Small-Cap companies. Thus, the median CEO equity ownership in SMI companies is 0.01 percent, while it corresponds to 0.03 percent and 0.10 percent in Mid-Cap and Small-Cap firms, respectively. CEO participation in Small-Cap firms is more wide-spread and reaches higher total levels than in the other indices brackets. The mean share ownership of Small-Cap firms is 2.5 percent of total market capitalization.

Next, inspecting the value of CEO equity holdings in Panel B of Table VII reveals that the median CEO in our sample holds about CHF 1.16 million of his wealth in company's equity capital. Strikingly, CEOs of SMI companies hold on average more than three times the amount of wealth in firm's equity than CEOs of Mid-Cap and Small-Cap companies. Thus, the median CEOs holds roughly CHF 2.93 million in equity. Overall, absolute CEO wealth increases over time and even surpasses the average growth of the stake held in firm's equity capital.

Remarkably, we observe a general increase in the stake of equity participation rate. The proportion of CEOs that do not hold any shares drops

Table VI

Pay for Luck – SECTOR

This table provides estimated coefficients from 2SLS regressions on CEO Pay. The dependent variable is the logarithm of CEO pay, where *TOTAL COMP* captures annual total compensation, *BASE CASH PAY* represents the sum of guaranteed cash remuneration, *VARIABLE CASH* is the amount of cash bonus payments, and *LTIP* is the sum of long-term-incentive programme (containing fix and variable equity payments). Specification captures whether the regressions were run in the general pay-performance setting (General) or as 2SLS-regression (Sector), where performance was instrumented with FAVORABLE, the firm's domestic sector index return. *NO OF DIRECTORS* captures the total number of Directors in the company's board. *EQUITY OWNED* is the absolute number of shares held by the CEO divided by the total number of outstanding shares, and *BETA* is a static factor capturing the stock related movements in its price to movements in the market as a whole. *ln(TOTAL ASSETS)* is the logarithm of the firm's total assets, reported in CHF. The t-statistics are adjusted for clustering of standard errors by firm, and ∗, ∗∗, and ∗∗∗ indicate significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variable	ln(TOTAL PAY)		ln(BASE CASH PAY)		ln(VARIABLE CASH)		ln(LTIP)	
Specification	General	Sector	General	Sector	General	Sector	General	Sector
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Performance captured by return on assets.								
ln(1+ROA)	0.144**	0.965**	0.017	0.850	0.456	-0.493	1.377***	0.713
	(2.24)	(2.04)	(0.16)	(0.75)	(1.11)	(-0.22)	(3.01)	(0.33)
NO OF DIRECTORS	-0.017	-0.026	-0.125	-0.019	-0.186	-0.226	0.086	0.077
	(-0.67)	(-0.48)	(-1.19)	(-0.10)	(-0.85)	(-0.73)	(0.51)	(0.29)
EQUITY OWNED	-0.362	0.578	0.078	1.999	-3.310	-2.214	-15.862***	-17.149***
	(-0.72)	(0.44)	(0.06)	(1.08)	(-0.51)	(-0.33)	(-4.88)	(-4.74)
BETA	0.206	0.499***	0.565	0.904*	-0.410	-0.604	0.426	0.449
	(0.96)	(2.88)	(1.38)	(1.75)	(-0.55)	(-0.75)	(0.55)	(0.52)
ln(TOTAL ASSETS)	0.237***	0.480***	0.311**	0.492	0.244	0.133	0.872***	0.812
	(3.65)	(3.00)	(2.14)	(1.28)	(0.89)	(0.20)	(3.32)	(1.20)
Constant	10.543***	4.967	8.084***	2.500	8.361**	12.690	-6.716	-4.334
	(10.47)	(1.56)	(4.12)	(0.35)	(2.08)	(0.93)	(-1.53)	(-0.32)
Sample Size	414	414	414	414	414	414	414	414
Adjusted R^2	0.18		0.030		0.032		0.14	
F-stat of excluded instrument		4.710		4.710		4.710		4.710
Panel B: Performance captured by return on equity.								
ln(1+ROE)	0.491**	23.831	-0.176	33.086	4.310***	50.207	2.921*	11.455
	(2.17)	(0.42)	(-0.48)	(0.37)	(2.73)	(0.40)	(1.65)	(0.16)
NO OF DIRECTORS	-0.006	0.356	-0.115	0.478	-0.081	0.420	0.210	0.325
	(-0.21)	(0.43)	(-1.26)	(0.38)	(-0.39)	(0.23)	(1.16)	(0.35)
EQUITY OWNED	-1.151***	3.937	-1.232	7.382	-5.703	3.818	-14.988***	-15.249
	(-2.94)	(0.35)	(-0.72)	(0.43)	(-1.29)	(0.16)	(-3.76)	(-1.06)
BETA	0.177	1.788	0.573	2.847	-0.466	2.528	0.036	0.904
	(0.84)	(0.52)	(1.43)	(0.52)	(-0.62)	(0.32)	(0.04)	(0.20)
ln(TOTAL ASSETS)	0.189***	-0.467	0.276**	-0.717	0.155	-1.037	0.386	0.203
	(3.19)	(-0.26)	(2.39)	(-0.26)	(0.68)	(-0.27)	(1.46)	(0.10)
Constant	11.408***	13.312	8.633***	11.588	8.879***	13.149	2.410	2.218
	(13.29)	(1.43)	(5.73)	(0.83)	(2.98)	(0.70)	(0.61)	(0.26)
Sample Size	459	459	459	459	459	459	459	459
Adjusted R^2	0.16		0.028		0.060		0.12	
F-stat of excluded instrument		0.161		0.161		0.161		0.161

massively – the most pronounced for in SMI and Mid-Cap companies from half of CEOs to around one fifth in 2011.[13] Panel B of Table VII also displays a certain size effect as the increase in CEO equity participation is more distinct in SMI and Mid-Cap companies. However, note that equity participation in Small-Cap is higher – three out of four CEOs held an equity stake already in 2007.

Finally, in Panel C of Table VII we set the absolute level of CEO equity wealth in relation to the CEO's annual fix cash pay. For an average CEO in our sample, a ratio of around 1.8 implies that around 2 annual base cash payments are held in the company's equity capital.

Overall, the shareholding-to-cash multiplier increases massively over time as well as in each of the industry brackets. Thus, in 2007 the median SMI-CEO holds only about one fifth of his annual cash reward in firm's equity. In 2011 however, equity holdings increased reaching two times the annual cash reward. Interestingly, equity participation increased the most for CEOs of Small-Cap firms.

Lastly, observing a general increase of the mean-median-ratio over all brackets and over time, we observe a decreasing tendency of extreme values.

We conclude that equity participation gained in importance of the sheer holding of equity as well as concerning the CEOs' wealth that is allocated in firms equity.

Next, we evaluate the equity holdings of the members of the executive board. An inspection of Table VIII reveals that overall executive equity participation is less pronounced. Thus, firm's executives hold, with an average of 0.4 percent, only half of the equity stake than CEOs.

The observation of the figures for relative ownership of executives in Mid-Cap and Small-Cap firms shows, similar patterns of executive equity participation as for the group of CEOs. Interestingly, although showing lower holdings of equity, the value of the corresponding equity positions is similar to

[13] It is conceivable, though arguably unlikely, that these changes are due to companies not correctly reporting data in 2007.

the CEO's equity stake. This implies that the executives hold larger fractions in particularly valuable companies, relative to CEOs.

Finally, the inspection of the shareholdings-to-cash multiplier reveals that primarily executives of SMI and Mid-Cap firms increase the amount of wealth allocated in firm equity. Thus, the ratio increases from between one tenth and fifth to around twice annual salaries and one annual salary for Mid-Cap firms respectively. In contrast, executives in Mid-Cap firms even decrease the ratio of salary held in equity over the sample period

Overall, especially CEOs have to hold or hold voluntarily an increasingly large amount of their personal wealth in their firms' equity. This pattern seems to occur especially in larger firms, whereas executives in smaller companies do not participate as much.

To conclude this investigation, we note that generally, equity wealth holdings are much higher for U.S. executives. Using data from ExecuComp for (roughly) the largest 1,500 corporations, we construct Table IX. The median CEO of the largest 1,500 U.S. companies owns around 0.72 per cent of the firm's market value. This corresponds to USD 7.5 million and around 11 time the annual salary. These numbers are significantly higher than those for Switzerland.[14]

5.2. Wealth Changes

Table X presents descriptive statistics for the levels of director's absolute equity wealth changes per year. The absolute individual wealth is captured by the average shareholding per year, valued with the company's share price at the end of the corresponding year. Average shareholding is considered as the average amount of shares held at the end of the previous year and the holding in the corresponding year.

[14] One caveat regarding the analysis in the section is that we were not able to consider options and other types of equity-based compensation. Especially in the U.S. a significant part of the wealth held in the company's equity are options. The value of the options for a median CEO is around 3 percent of the companies market capitalization. However, the ratio is subject to heavy fluctuations. Due to inconsistent and qualitative limitations valid interpretations are difficult for Switzerland.

Table VII

CEO Wealth and Ownership

This table presents descriptive statistics of CEO wealth and ownership. Panel A displays the proportion of shareholdings of a CEO, standardized by the total amount of shares outstanding. This proportion is reported in percent. Panel B shows the total value of CEO ownership in shares; therefore the total number of shares a CEO holds at the end of each year is valued with the company's share price at the end of the corresponding year. Panel C displays the ratio of the value of CEO shareholdings standardized by the annual fix cash pay; the value of shareholdings of Panel B were divided by yearly fix pay of the CEO. *SMI*, *MID-CAP* and *SMA-CAP* capture the index bracket the company belongs to, where, SMI capture the Swiss market index; the Mid-CAP bracket and Small-Cap bracket, respectively. *No shld* is the proportion of CEOs that does not own any shares in the corresponding company.

	Overall sample					SMI					MID-CAP					SMA-CAP				
year	median	p25	p75	mean	no shld.	median	p25	p75	mean	no shld.	median	p25	p75	mean	no shld.	median	p25	p75	mean	no shld.
Panel A: CEO relative ownership in company's share capital (in percent)																				
2007	0.02	0.00	0.13	0.78	0.36	0.00	0.00	0.02	0.01	0.50	0.00	0.00	0.05	0.43	0.52	0.08	0.00	0.27	1.23	0.24
2008	0.03	0.00	0.15	1.47	0.20	0.02	0.00	0.05	0.25	0.15	0.02	0.00	0.06	0.25	0.31	0.10	0.02	0.36	2.57	0.16
2009	0.05	0.01	0.18	1.50	0.19	0.02	0.00	0.04	0.23	0.15	0.04	0.01	0.10	0.32	0.21	0.10	0.01	0.65	2.74	0.19
2010	0.04	0.01	0.21	1.63	0.18	0.01	0.00	0.03	0.20	0.22	0.03	0.01	0.08	0.21	0.19	0.09	0.02	0.68	3.12	0.15
2011	0.06	0.01	0.22	1.59	0.18	0.01	0.01	0.03	0.22	0.20	0.06	0.01	0.12	0.23	0.19	0.14	0.03	0.66	2.93	0.17
Total	0.04	0.00	0.18	1.40	0.22	0.01	0.00	0.03	0.18	0.24	0.03	0.00	0.07	0.28	0.27	0.10	0.02	0.46	2.50	0.18
Panel B: CEO value of ownership in company's share capital (in Mio. CHF)																				
2007	0.71	0.00	4.74	15.70		0.17	0.00	6.11	9.06		0.00	0.00	1.50	26.00		0.90	0.02	5.47	14.00	
2008	0.87	0.07	3.10	15.50		2.99	0.58	11.30	28.70		0.43	0.00	1.32	6.77		0.83	0.05	2.67	15.00	
2009	1.35	0.11	4.73	23.40		3.97	0.77	11.60	28.00		1.13	0.09	4.24	8.05		1.08	0.13	4.21	30.80	
2010	1.84	0.20	6.91	24.90		3.33	0.04	12.30	25.50		1.11	0.39	6.37	7.74		1.27	0.17	6.59	34.10	
2011	1.73	0.16	5.20	11.00		4.20	0.88	13.60	15.00		1.41	0.08	4.12	3.60		1.48	0.14	3.83	13.50	
Total	1.16	0.06	5.03	18.16		2.93	0.17	10.60	21.40		0.86	0.00	3.12	9.72		1.06	0.11	4.41	21.30	
Panel C: Ratio of value shareholdings to yearly fix cash pay																				
2007	1.05	0.00	4.37	29.54		0.20	0.00	4.15	4.50		0.00	0.00	2.85	22.24		1.52	0.04	9.97	43.22	
2008	0.97	0.12	4.00	20.43		1.70	0.59	8.45	12.23		0.52	0.00	1.29	4.44		1.30	0.12	6.12	32.86	
2009	1.90	0.23	6.08	33.00		1.98	0.75	7.22	11.56		1.41	0.17	4.24	5.19		2.34	0.27	7.82	61.08	
2010	2.55	0.52	7.84	38.41		2.19	1.34	4.95	15.94		1.22	0.18	7.61	7.57		3.17	0.71	10.98	68.03	
2011	2.19	0.22	6.56	21.33		2.12	1.08	8.80	11.90		1.71	0.18	4.72	6.09		3.00	0.37	7.29	34.17	
Total	1.75	0.13	6.00	28.51		1.96	0.20	6.14	11.33		0.96	0.00	4.00	8.48		2.24	0.19	7.60	47.49	

Table VIII

Executives Wealth and Ownership

This table presents descriptive statistics of executive board members wealth and ownership. Panel A displays the proportion of shareholdings of a executives, standardized by the total amount of shares outstanding. This proportion is reported in percent. Panel B shows the total value of executives ownership in shares; therefore the total number of shares an executive holds at the end of each year is valued with the company's share price at the end of the corresponding year. Panel C displays the ratio of the value of executive shareholdings standardized by the annual fix cash pay; the value of shareholdings of Panel B were divided by yearly fix pay of the CEO. *SMI*, *MID-CAP* and *SMA-CAP* capture the index bracket the company belongs to, where, SMI capture the Swiss market index; the MID-CAP bracket and Small-Cap bracket, respectively. *No shld* is the proportion of executives that does not own any shares in the corresponding company.

	Overall sample					SMI					MID-CAP					SMA-CAP				
year	median	p25	p75	mean	no shld.	median	p25	p75	mean	no shld.	median	p25	p75	mean	no shld.	median	p25	p75	mean	no shld.
Panel A: Executive relative ownership in company's share capital (in percent)																				
2007	0.01	0.00	0.11	0.50	0.38	0.00	0.00	0.00	0.02	0.54	0.00	0.00	0.08	0.38	0.49	0.12	0.01	0.47	1.01	0.16
2008	0.02	0.00	0.12	0.32	0.28	0.00	0.00	0.01	0.02	0.43	0.02	0.00	0.07	0.07	0.26	0.11	0.04	0.29	0.75	0.15
2009	0.02	0.00	0.15	0.63	0.27	0.00	0.00	0.01	0.55	0.35	0.05	0.00	0.15	0.11	0.30	0.15	0.04	0.42	1.12	0.14
2010	0.02	0.00	0.13	0.38	0.28	0.00	0.00	0.01	0.53	0.34	0.03	0.00	0.12	0.09	0.34	0.17	0.02	0.31	0.43	0.15
2011	0.02	0.00	0.16	0.18	0.19	0.00	0.00	0.02	0.03	0.21	0.08	0.02	0.19	0.14	0.13	0.13	0.02	0.38	0.37	0.19
Total	0.02	0.00	0.14	0.41	0.28	0.00	0.00	0.01	0.24	0.38	0.03	0.00	0.12	0.15	0.31	0.13	0.02	0.38	0.74	0.16
Panel B: Executive value of ownership in company's share capital (in Mio. CHF)																				
2007	0.65	0.00	3.26	19.70		0.00	0.00	1.84	10.70		0.02	0.00	3.26	34.00		1.40	0.05	6.52	20.30	
2008	0.67	0.00	3.03	6.37		0.60	0.00	5.82	6.70		0.54	0.00	1.11	2.13		0.87	0.12	2.85	8.48	
2009	1.48	0.00	5.51	94.10		1.57	0.00	6.95	223.00		0.94	0.00	3.53	3.30		1.51	0.22	5.51	10.90	
2010	1.52	0.00	5.52	138.00		2.04	0.00	7.57	341.00		1.19	0.00	4.83	3.47		1.52	0.24	5.28	6.04	
2011	1.58	0.16	6.54	6.83		1.88	0.10	7.78	10.20		2.09	0.57	5.80	3.81		1.01	0.05	4.83	4.90	
Total	1.09	0.00	4.83	55.20		1.07	0.00	6.33	125.00		0.78	0.00	3.45	8.75		1.33	0.12	4.55	10.20	
Panel C: Ratio of value shareholdings to yearly fix cash pay																				
2007	0.85	0.00	3.04	37.16		0.16	0.00	2.26	3.70		0.11	0.00	2.45	8.42		1.26	0.40	4.69	87.43	
2008	0.58	0.00	2.54	12.05		0.79	0.00	3.26	3.19		0.35	0.01	1.60	1.00		0.73	0.11	2.76	27.65	
2009	1.06	0.02	3.45	140.49		1.60	0.00	4.96	333.75		0.71	0.02	2.61	2.02		0.90	0.31	9.65	17.31	
2010	1.32	0.20	5.01	434.16		2.48	0.20	5.28	1165.32		0.70	0.00	4.54	2.82		1.17	0.33	6.42	13.64	
2011	1.17	0.19	3.74	7.18		1.92	0.32	5.45	5.23		1.08	0.29	2.98	2.50		0.95	0.16	2.68	11.41	
Total	0.92	0.03	3.63	130.01		1.33	0.00	4.37	301.83		0.65	0.00	2.53	3.22		0.95	0.24	3.65	30.87	

Table IX

U.S. Wealth and Ownership

This table presents descriptive statistics of U.S. CEO and executive wealth and ownership of S&P1500 firms. Panel A displays the proportion of individual shareholdings standardized by the total amount of shares outstanding. This proportion is reported in percent. Panel B shows the total value of individual executive ownership in shares; the total number of shares a individual holds at the end of each year is valued with the company's share price at the end of the corresponding year. Panel C displays the ratio of the value of individual shareholdings standardized by the annual fix cash pay; therefore the value of shareholdings of Panel B were divided by yearly fix pay of the CEO. *No shld* is the proportion of individuals that does not own any shares in the corresponding company.

	CEO					Board & Other Executives				
	median	p25	p75	mean	no shld.	median	p25	p75	mean	no shld.
Panel A: Relative ownership in company's share capital (in percent)										
2000	1.47	0.49	5.91	5.18	0.04	2.29	0.70	9.07	6.84	0.04
2001	1.35	0.45	4.80	4.68	0.10	1.95	0.60	7.69	6.12	0.10
2002	1.10	0.37	4.07	4.34	0.12	1.60	0.49	6.59	5.80	0.12
2003	1.05	0.35	3.50	3.86	0.12	1.47	0.48	5.62	5.40	0.12
2004	1.03	0.34	3.28	4.03	0.09	1.33	0.46	5.37	5.56	0.09
2005	1.01	0.34	3.16	3.77	0.02	1.33	0.45	5.20	5.09	0.02
2006	1.04	0.34	3.21	3.97	0.01	1.37	0.45	5.30	5.58	0.01
2007	0.93	0.32	3.33	4.01	0.02	1.14	0.32	4.34	5.26	0.02
2008	0.97	0.36	3.10	3.93	0.01	1.10	0.27	3.79	5.17	0.01
2009	0.36	0.12	1.13	2.00	0.01	0.83	0.30	2.43	3.22	0.01
2010	0.33	0.11	1.03	1.75	0.01	0.78	0.30	2.08	2.93	0.01
2011	0.33	0.11	1.03	1.60	0.01	0.80	0.29	2.09	2.74	0.01
Total	0.72	0.22	2.43	3.29	0.04	1.15	0.38	4.18	4.73	0.04
Panel B: Value of ownership on company's share capital (in Mio. USD)										
2000	10.39	2.33	54.48	200.96		24.07	6.42	94.06	306.46	
2001	9.45	2.03	45.30	176.96		21.36	5.40	92.15	260.29	
2002	6.93	1.40	30.57	157.14		14.71	3.72	61.14	210.26	
2003	8.96	2.21	43.04	160.95		17.84	5.51	74.41	217.40	
2004	10.02	2.42	43.34	169.92		20.51	5.89	82.62	260.90	
2005	10.73	2.61	41.06	154.01		21.93	6.48	84.62	260.18	
2006	11.70	3.05	43.07	176.15		25.45	8.17	93.65	278.60	
2007	8.39	2.29	34.99	634.30		20.57	5.88	75.77	708.82	
2008	5.26	1.38	17.87	251.69		12.84	3.93	39.49	297.53	
2009	6.02	2.05	18.19	65.90		13.75	5.11	37.57	112.63	
2010	7.12	2.62	20.14	83.58		16.32	6.51	42.60	127.41	
2011	7.15	2.74	19.73	66.83		16.86	6.81	41.24	109.01	
Total	7.70	2.23	29.09	185.65		17.85	5.72	60.01	252.45	
Panel C: Ratio of value shareholdings to yearly fix cash pay										
2000	19.31	4.52	108.14	683.57		56.62	15.91	224.03	943.54	
2001	17.07	3.97	78.50	681.41		51.27	14.26	191.00	856.75	
2002	11.52	2.63	54.71	574.61		32.91	9.38	125.92	668.69	
2003	14.64	4.08	70.40	659.19		43.05	13.53	157.67	765.74	
2004	16.04	4.44	68.79	671.62		43.84	14.50	159.06	1,133.09	
2005	15.79	4.48	61.22	663.42		47.20	14.93	167.98	817.06	
2006	17.03	4.96	65.19	614.12		53.39	18.35	169.37	774.86	
2007	12.03	3.73	51.82	3,388.47		43.08	14.19	135.95	3,435.37	
2008	7.38	2.20	25.95	1,917.38		25.04	8.84	75.19	1,967.18	
2009	7.93	2.97	22.08	211.99		26.62	10.73	63.74	274.03	
2010	8.94	3.71	23.52	188.73		29.66	13.35	68.26	245.58	
2011	8.98	3.70	22.41	185.95		29.26	13.49	63.54	239.36	
Total	11.24	3.56	41.96	851.30		35.33	12.94	112.49	973.69	

In 2008, at least three out of four CEOs, chairmen and other board members suffered net wealth reductions resulting from plunging share prices. In 2009, we observed the mirror image, that is at least 75% of the persons surveyed benefited from rising share prices. In 2010 however, an intermediate result occurred. The median CHF wealth change due to ownership was around zero or slightly positive for all three groups.

The difficult market environment in 2011 led to broad losses throughout, and so the gains the median CEO, chairman and director had made in 2009 and 2010 essentially evaporated in 2011. The wealth changes of the middle half of CEOs, chairmen, and other board members are in a relatively narrow range around the median. 50% of all CEOs, that is between lower and upper quartile, experienced wealth changes in the amount of CHF -900,000 to CHF +100,000. For chairmen, this range is from CHF -730,000 to CHF +90,000 for 2010. For other board members, this range amounts to CHF -230,000 to CHF -10,000 for 2011 compared to CHF -50,000 to CHF +110,000 for 2010.

While in 2010, the distribution of wealth changes was relatively symmetric – with the average wealth change approximating the median – in 2011, this distribution was again highly skewed (as had been the case in 2008 and 2009). For example, in 2011, the average CEO lost CHF 3,8 million while the median lost "only" CHF 400,000. This applies similarly for chairmen and other board members.

The percentage wealth change, defined as the wealth change of a disclosed person expressed as a percentage of the wealth he holds in shares of his company, can be substantial: In SMI and Mid-Cap companies, the median percentage wealth change of CEOs in 2011 was -14.6%. For other board members, this number was -13.6%, for chairmen it was -12.7%. In Small-Cap firms, these numbers were -20.2%, -16.4%, and -24.2%, respectively.

Overall, these results suggest that in a market environment as volatile as the one we have witnessed over the past years, Swiss executives and board

Table X

Wealth Changes

This table presents descriptive statistics for the levels of director's absolute equity wealth changes per year. The absolute individual wealth is captured by the average shareholding per year, valued with the company's share price at the end of the corresponding year; average shareholding is the average amount of shares held at the end of the previous year and the holding in the corresponding year.
The absolute wealth changes are reported in Mio. CHF.

	SMI and Mid-cap companies					Small-Cap companies				
	max	p25	p75	min	median	max	p25	p75	min	median
Panel A: Absolute wealth changes of CEOs (in Mio. CHF)										
2008	42.827	-0.285	-1.884	-218.788	-0.828	0.319	-0.056	-4.834	-79.747	-0.323
2009	10.315	0.985	0.059	-35.268	0.482	495.006	0.781	0.004	-5.728	0.069
2010	11.620	0.979	-0.008	-21.115	0.231	41.940	0.913	0.018	-184.497	0.118
2011	8.274	-0.105	-0.897	-99.275	-0.399	0.110	-0.001	-1.520	-690.150	-0.207
Panel B: Absolute wealth changes of Chairmen (in Mio. CHF)										
2008	6.342	-0.308	-33.518	-2,745.093	-2.740	0.155	-0.080	-1.828	-291.441	-0.237
2009	2,173.719	3.095	0.013	-30.078	0.246	210.701	0.293	0.001	-0.517	0.068
2010	1,899.800	0.407	-0.110	-32.085	0.079	177.387	0.710	0.002	-12.641	0.099
2011	4.411	-0.091	-0.726	-9.318	-0.327	0.220	-0.004	-0.636	-51.169	-0.060
Panel C: Absolute wealth changes of other members of the board of Directors (in Mio. CHF)										
2008	4.732	-0.059	-0.667	-3,014.274	-0.209	0.106	-0.007	-0.261	-401.006	-0.040
2009	1,442.614	0.236	0.007	-318.185	0.054	210.701	0.059	0.000	-2.765	0.010
2010	293.772	0.106	-0.048	-586.749	0.008	191.854	0.078	0.000	-17.850	0.015
2011	44.447	-0.010	-0.235	-1,567.438	-0.068	1.955	0.000	-0.159	-66.106	-0.021

members are exposed to significant wealth risk through their equity holdings, even though the absolute holdings are relatively small compared to their counterparts in U.S. firms. Given that stock price developments are to a significant extent driven by general market developments, this again suggests a substantial element of exposure to exogenous factors. While economic theory suggests that some degree of such exposure can be useful – for example, for retention purposes – boards should think carefully about whether the particular setting in their company is appropriate given the characteristics of their industry and the contributions of the executives.

6. Disclosure of Compensation

6.1. Introduction to Disclosure

The disclosure of statements about corporate governance of Swiss listed companies is required by law based on the Swiss Code of Obligations. That code mainly concerns the disclosure of levels of compensation. In the recent

years several new requirements became effective that particularly address the disclosure of statements about the process and about other substantive issues in management compensation.

In particular, the SIX Exchange Regulation is responsible for the enforcement of issuer regulation in accordance with the SIX Swiss Exchange stock exchange law. In its Directive on Information[15] relating to Corporate Governance it requires issuers to disclose important information on their board and executives.[16] With its circular 8/2010, the SIX has amplified the relevancy of corporate governance disclosures by emphasizing that in its 2010 review of annual reports it would pay particular attention to whether the rules are being adhered to.

However, compliance to disclosure requirements is not a simple matter when it comes to compensation disclosure and listed companies need to be aware of several different standards in deciding what needs to be disclosed. Additionally, the Directive Corporate Governance is itself not particularly detailed, and there are several additional relevant documents that our assessment also incorporates. First, the Commentary to the Directive provides a number of more detailed points. Second, on November 24, 2010, the SIX provided some additional guidance on particular aspects of disclosure. Third, additional information can be read out of the published decisions of the SIX sanctions commission.

6.2. Descriptive Statistics

Having recognized the inexistence of any clear regulatory requirements for corporate governance disclosure, we employ a rating system that aims at capturing the rules that companies currently need to comply with as far as the SIX Exchange Regulation is concerned. This rating system was first presented in PricewaterhouseCoopers (2011), summarized in a scorecard for disclosure

[15] Note that the Directive Corporate Governance also covers other aspects of disclosure not related to compensation.

[16] Companies do also have the right to obtain certain information; however this has to be justified substantially.

in annual reports comprising 24 criteria.[17] The description of the system follows PricewaterhouseCoopers (2011).

The general guiding principle that companies need to follow is that the principles and elements of compensation (the design and determining mechanisms, as well as details of any shareholding program and how it works) must be explained to investors in terms that are as comprehensible as possible.

Onto this general principle follow several more specific requirements, which we hence chosen to summarize under three headings.

Topic A (Requirements regards the process of how pay is set) covers requirements regarding the process of how pay is set. The key points of the process used to determine compensation and participation in the shareholding program must be described. This includes, but is not limited to, issues such as competencies of various bodies, who have a vote in a relevant meeting, whether external advisors are consulted, and whether part of the compensation is given on a discretionary basis.

Topic B (Requirements regarding the substance of the compensation system) related to requirements regarding the substance of the compensation system. Companies have to describe which goals are taken into account when structuring compensation and share-ownership programs, and how strongly individual goals and other components are taken into account. Non-GAAP measures need to be explained. Moreover, companies are required to disclose whether benchmarks or salary comparisons have been used; if so, the benchmarks and salary comparisons selected must be disclosed and the choice of benchmarks and reference salaries must be explained as transparently as possible. Furthermore, the composition of pay needs to be detailed in various ways, using easy-to-understand quantitative analysis, and share and option planed need to be explained exactly.

[17] The scorecard is PricewaterhouseCoopers' reading of the SIX Exchange Regulation's rules. It is not an official rating and was developed without any involvement of SIX Exchange Regulation.

Topic C (Requirements regarding the evaluation of payments and other requirements) explanation of in-kind payments, special payments, especially those made upon leaving the company, and related topics.

On each of the 24 criteria, companies were rated with a grade of 0, 1, or 2. First determined whether a given criterion is addressed at all in a report. If it was addressed, a score of 2 was given if an issuer fully and understandably covered the issue or used the "explain" clause, that is the issuer did not disclose the issue, but explained why it did so. A score of one was given if the criterion was partially addressed, and a score of 0 was given if the issuer used too general explanation or incomprehensible prose. If a criterion was not mentioned at all, we assigned a score of 0 due to the apparent violation of disclosure requirements.

However, for some criteria it was possible that they did not apply to a given company (for example, when no "special rules" exist for some managers, they cannot be disclosed), and in this case we did not take this criterion into account for calculation of the total number of reachable points for this company. The total compliance score for a company was then calculated as the ratio of the sum of the total number of points achieved to the total number of reachable points.

Figure 8 presents an overview of the compliance scores for SMI and Mid-Cap firms from 2009 to 2011. In order to capture overall patterns, we sort the scores by year in ascending order. Overall, we observe a general increase in disclosure quality. As the median score increases constantly, we interpret this as evidence for a general establishment of minimum disclosure standards.

Thus, in 2009 firms had to reach a score of at least 50% to be in the upper half of the sample distribution. The minimum threshold level between the upper and lower half of the distribution increased constantly over time.

Thus, in 2011, the disclosure score of at least 75% was required to be in the upper bracket.

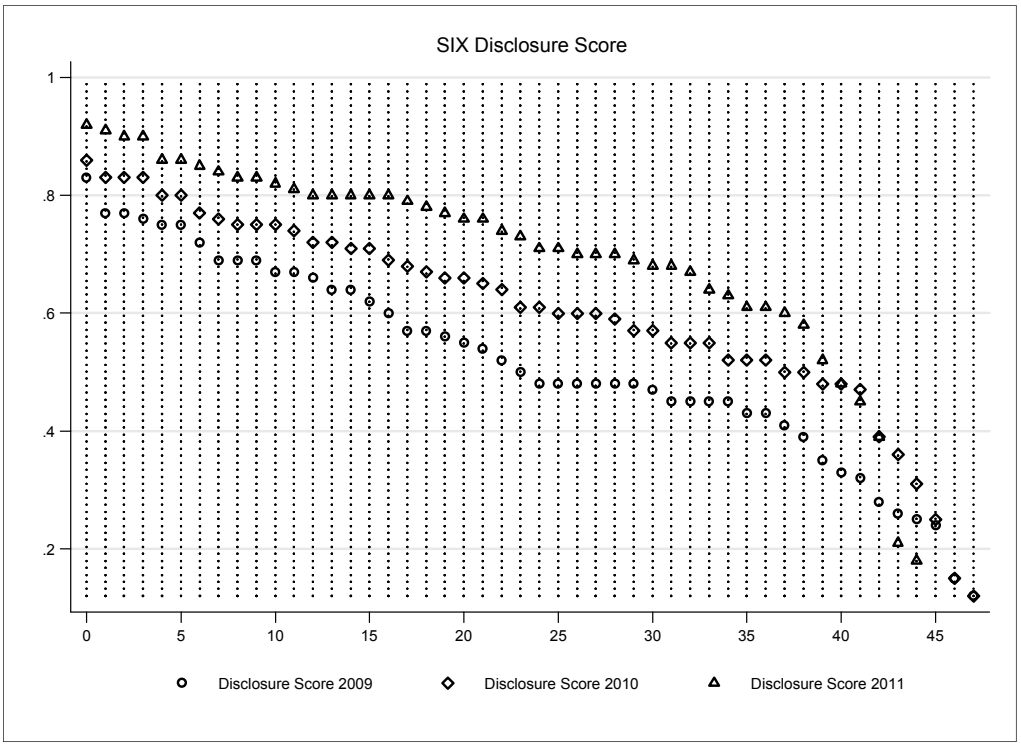

Figure 8: SIX Disclosure Score. This figure presents the developments of the disclosure score for SMI and Mid-Cap companies from 2009 to 2011.

Next, Figure 10 displays the disclosure score ranked on the score reached in 2009. We find that only 5 out of 50 firms worsened their disclosure over time. The remainder of firms improved its disclosure quality constantly. Especially the group of companies that exhibited the lowest compliance in 2009 revealed the largest improvements. Naturally, annual improvements decrease the higher the initially achieved score was.

6.3. Regression Results

As a final step in our analysis, we now briefly consider the potential correlation of disclosure quality with general pay levels. Two hypotheses appear plausible. On the one hand, disclosure of more detailed and private information about the pay-setting process, such as insight into the substance and calculations, may imply that average pay diminishes as discretionary parts become public and have to be justified to shareholders. On the other hand, it could be that better disclosure enables firms to substantiate complex and discretionary components of total executive pay.

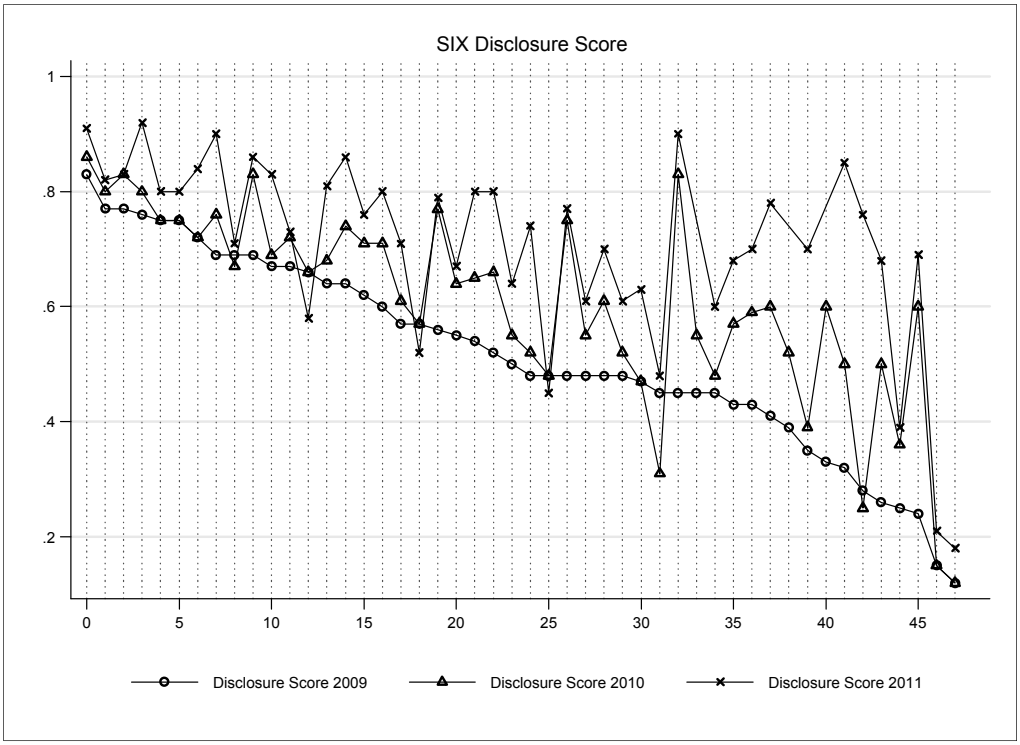

Figure 9. SIX Disclosure Score. This figure presents the developments of disclosure score for SMI and Mid-Cap companies from 2009 to 2011; the ranking is based on the disclosure score reached in 2009.

Table X shows that the DISCLOSURE SCORE is not highly significantly associated with pay levels. If at all, firms with better disclosure tend to pay more (even controlling for size, performance, and other factors).

7. Conclusions

This is one of the first comprehensive investigations of executive pay practices in Swiss companies. Both mandatory and voluntary disclosure of compensation have improved significantly over time. We document that in the time period for which detailed compensation data are available, there have been few strong trends in compensation. We do observe a general increase in the stake of equity participation that is most pronounced for larger companies. Furthermore, concomitantly with increasing equity participation, accumulated CEO equity wealth increases as well – binding executives even more to the general firm's success. The level of equity participation is, however, is still far below that of other countries, the U.S. for example. Drawing on a

Figure X

Compensation and Disclosure

This table presents panel regressions of CEO total compensation on disclosure scores, performance and control variables . The dependent variable is the logarithm of the CEO total compensation defined as the sum of base pay, bonus, the long-term incentive payments and the value of other granted remuneration in the given year. CEO pay is reported in CHF. *DISCLOSURE SCORE* represents the score of the disclosure analysis. *ln(ROA)* (return on assets) is the logarithm of the ratio of earnings before interest, taxes, depreciation, and amortization (EBITDA), divided by the firm's total assets. *ln(ROE)* is the logarithm of the ratio of EBITDA divided by shareholder's equity. *ln(TOT_RET)* is the logarithm of the total return of holding the share of the company over the last year; this assumes that dividends are re-invested to purchase additional units of the equity. *NO OF DIRECTORS* captures the total number of directors in the company's board. *EQUITY OWNED* is the absolute number of shares held by the corresponding CEO divided by the total number of outstanding shares. *BETA* is a static factor capturing the stock related movements in its price relative to movements in the market as a whole. *ln(TOTAL ASSETS)* is the logarithm of the firm's total assets, reported in CHF. *Sector Controls* are binaries that equal one for each of different industry sectors the corresponding company is assigned by the Swiss stock exchange. The t-statistics are adjusted for clustering of standard errors by firm. ∗, ∗∗, and ∗∗∗ indicate significance at the 10%, 5%, and 1% levels, respectively. Time and industry dummies are included but not reported.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
DISCLOSURE SCORE	0.698	0.724	0.740	0.602	0.698	0.675	0.792	0.937*	0.732	0.949
	(1.40)	(1.43)	(1.44)	(1.16)	(1.37)	(1.27)	(1.52)	(1.76)	(1.36)	(1.63)
ln(1+ROA)	0.234*	0.206*	0.240**							
	(1.91)	(1.96)	(1.97)							
ln(1+ROE)				0.338	0.202	0.397				
				(0.42)	(0.34)	(0.52)				
ln(1+EBITDA)							0.098	0.070		
							(1.15)	(1.19)		
L.ln(TOTAL RETURN)									0.218***	0.201**
									(2.68)	(2.50)
NO OF DIRECTORS		0.024			0.068**			0.056*		0.049
		(0.92)			(1.97)			(1.90)		(1.46)
EQUITY OWNED			9.211			15.433		16.583		14.390
			(0.65)			(0.79)		(0.87)		(1.15)
BETA	0.266	0.236	0.276	0.155	0.104	0.172	0.150	0.118	0.379	0.383
	(0.62)	(0.56)	(0.64)	(0.37)	(0.26)	(0.41)	(0.34)	(0.27)	(0.67)	(0.69)
ln(TOTAL ASSETS)	0.174	0.151	0.175	0.167	0.095	0.168	0.087	0.031	0.378***	0.327***
	(0.93)	(0.80)	(0.93)	(0.93)	(0.52)	(0.93)	(0.45)	(0.15)	(3.76)	(3.48)
Constant	11.017***	11.224***	10.928***	11.994***	12.444***	11.880***	13.011***	13.248***	8.453***	8.569***
	(3.72)	(3.82)	(3.66)	(4.25)	(4.39)	(4.18)	(4.24)	(4.22)	(3.72)	(3.90)
Sample Size	133	133	133	142	142	142	128	128	106	106
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.14	0.14	0.14	0.13	0.14	0.13	0.11	0.12	0.48	0.52

comprehensive dataset of the extent to which companies comply with transparency requirements, we also document massive increases of disclosure quality for the largest 50 companies, probably prompted by several actions the

regulator has taken against noncompliant companies. Perhaps the most notable result of our study is that Swiss CEOs do experience pay for performance in general. We highlighted two facets of this relationship. First, pay for performance is stronger in larger companies. Second, Swiss CEOs appear to be exposed to external developments; performance driven purely by luck (bad luck) translates into higher (lower) pay. While the data suggest a general insignificance of governance influences, implying that there does not seem to exist a close entrenchment of Swiss CEOs, a natural question to ask is whether in better-governed firms there is less pay-for-luck. As more data become available, it will be possible to address this question.

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Supplementary Appendix

Table A.1

Overview of covered sectors

Sector	2007	2008	2009	2010	2011	Total
Basic Materials	7	7	6	6	4	30
Consumer Goods	6	7	8	8	6	35
Consumer Services	6	6	6	6	5	29
Financials	28	29	29	28	28	142
Health Care	12	13	13	12	12	62
Industrials	24	23	24	23	23	117
Oil & Gas	1	1	1	2	2	7
Technology	6	6	6	6	6	30
Telecommunications	1	1	1	1	1	5
Utilities	1	2	1	1	2	7
Total	92	95	95	93	89	

Table A.2

First-stage regression of Pay for Luck Analysis

This table presents estimated coefficients of the first-stage regression on the2SLS regression setting in Table V and Table VI. Two specifications are displayed: *EXCHANGE* and *SECTOR*. In specification *EXCHANGE* performance instrumented with the share of foreign sales multiplied by the Swiss franc nominal effective exchange rate. In specification *EXCHANGE* performance was instrumented with corresponding sector index return. *NO OF DIRECTORS* captures the total number of Directors in the company's board. *EQUITY OWNED* is the absolute number of shares held by the CEO divided by the total number of outstanding shares, and *BETA* is a static factor capturing the stock related movements in its price to movements in the market as a whole. *ln(TOTAL ASSETS)* is the logarithm of the firm's total assets, reported in CHF. The t-statistics are adjusted for clustering of standard errors by firm, and ∗, ∗∗, and ∗∗∗ indicate significance at the 10%, 5%, and 1% levels, respectively

Specification	Exchange FAVORABLE = ln(1+FOREIGNEXPOSURE)		Sector FAVORABLE = ln(1+SECTOR IND RETURN)	
Dependent Variable	ROA	ROE	ROA	ROE
FAVORABLE	0.199***	0.032***	0.766***	0.024
	(7.38)	(4.19)	(3.38)	(0.40)
NO OF DIRECTORS	0.048***	-0.016***	0.065***	-0.014***
	(2.93)	(-3.69)	(3.84)	(-3.06)
EQUITY OWNED	-1.293**	-0.224	-0.791	-0.188
	(-2.04)	(-1.42)	(-1.19)	(-1.16)
BETA	-0.461***	-0.108***	-0.165**	-0.061***
	(-5.90)	(-4.94)	(-2.35)	(-3.20)
ln(TOTAL ASSETS)	-0.260***	0.032***	-0.278***	0.029***
	(-10.69)	(5.10)	(-10.91)	(4.45)
Constant	5.576***	-0.188**	5.970***	-0.111
	(16.83)	(-2.14)	(17.41)	(-1.25)
Observations	414	459	414	459
R-squared	0.376	0.127	0.311	0.093
Year FE	Yes	Yes	Yes	Yes

Part III: CURRICULUM VITAE

Curriculum Vitae

Michael R. Reichenecker, born on October 01, 1982 in Stuttgart-Bad Cannstatt (Germany), studied Management and Economics. He earned his prediploma from the University of Hohenheim (Germany). Then, he switched to the University of Ulm (Germany) where he focused on Finance and Insurance Business. In 2008 he graduated with a Diploma thesis about Real Options and Discounted Cash Flow Valuation. During his studies he completed several international internships in various sectors. Subsequently after his graduation he began as a doctoral student and research and teaching assistant at the Department of Banking and Finance at the University of Zurich (Switzerland). He became a member of the team of Professor Alexander F. Wagner and had several teaching assistance responsibilities in undergraduate, graduate and executive educational courses. During his doctoral studies he attended several courses in banking, theoretical and empirical finance. His research interests covered corporate finance, international finance, market structure, asset pricing, financial risk and risk management. He graduated from his Ph.D. studies in October 2012.

Michael R. Reichenecker
Zurich, October 2012